# AWARD/CONTRACT

1. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700) | RATING:

2. CONTRACT (Proc. Inst. Ident.) NO: DJF-15-1200-K-0001730
3. EFFECTIVE DATE: 02/23/2015
4. REQUISITON/PURCHASE REQUEST/PROJECT NO.: DJF-15-2300-PR-0016673

5. ISSUED BY CODE: UNIT_CHIEF
FEDERAL BUREAU OF INVESTIGATION
MISSION SUPPORT CONTRACTS UNIT
935 PENNSYLVANIA AVE, NW
WASHINGTON, DC 20535-0001

6. ADMINISTERED BY (If other than Item 5) CODE: 1200
MISSION SUPPORT CONTRACTS UNIT
935 PENNSYLVANIA AVENUE, NW
WASHINGTON, DC 20535-0001

7. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)
NORTHWESTERN UNIVERSITY
1801 MAPLE AVE.
2ND FLOOR, SUITE 2410
EVANSTON, IL 60201
DUNS: 160079455

CODE: 362167817 FACILITY CODE: 160079455

8. DELIVERY: [ ] FOB ORIGIN [X] OTHER (See below)

9. DISCOUNT FOR PROMPT PAYMENT: NET 30

10. SUBMIT INVOICES (4 copies unless otherwise specified) TO THE ADDRESS SHOWN IN: ITEM G-1 & G-3

11. SHIP TO/MARK FOR CODE:
SEE SCHEDULE

12. PAYMENT WILL BE MADE BY CODE: 2500
CONTRACTS AND ACQUISTION MANAGEMENT U[redacted]
ATTN: [redacted] / ROOM # CC4
2400 SCHUSTER DRIVE
CHEVERLY, MD 20781-1211

b6 -1 Per FBI

13. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION:
[ ] 10 U.S.C. 2304(c) ( ) [ ] 41 U.S.C. 3304(a) ( )

14. ACCOUNTING AND APPROPRIATION DATA: See Lines

| 15A. ITEM NO. | 15B. SUPPLIES/SERVICES | 15C. QUANTITY | 15D. UNIT | 15E. UNIT PRICE | 15F. AMOUNT |
|---|---|---|---|---|---|
| 0001 | CLIN 0001, 0002, 0003<br><br>See Continuation Sheet(s) | 1.000000 | EA | $1,036,987.0000 | $1,036,987.00 |
| | | | | 15G. TOTAL AMOUNT OF CONTRACT | $1,924,321.00 |

16. TABLE OF CONTENTS

| (X) | SEC | DESCRIPTION | PAGE(S) | (X) | SEC. | DESCRIPTION | PAGE(S) |
|---|---|---|---|---|---|---|---|
| | | PART I - THE SCHEDULE | | | | PART II - CONTRACT CLAUSES | |
| | A | SOLICITATION/CONTRACT FORM | | | I | CONTRACT CLAUSES | |
| | B | SUPPLIES OR SERVICES AND PRICES/COSTS | | | | PART III - LIST OF DOCUMENTS, EXHIBITS AND OTHER ATTACH | |
| | C | DESCRIPTION/SPECS./WORK STATEMENT | | | J | LIST OF ATTACHMENTS | |
| | D | PACKAGING AND MARKING | | | | PART IV - REPRESENTATIONS AND INSTRUCTIONS | |
| | E | INSPECTION AND ACCEPTANCE | | | K | REPRESENTATIONS, CERTIFICATIONS AND OTHER STATEMENTS OF OFFERORS | |
| | F | DELIVERIES OR PERFORMANCE | | | L | INSTRS., CONDS., AND NOTICES TO OFFERORS | |
| | G | CONTRACT ADMINISTRATION DATA | | | M | EVALUATION FACTORS FOR AWARD | |
| | H | SPECIAL CONTRACT REQUIREMENTS | | | | | |

*CONTRACTING OFFICER WILL COMPLETE ITEM 17 (SEALED-BID OR NEGOTIATED PROCUREMENT) OR 18 (SEALED-BID PROCUREMENT) AS APPLICABLE*

17. [X] CONTRACTOR'S NEGOTIATED AGREEMENT *(Contractor is required to sign this document and return 1 copies to issuing office)* Contractor agrees to furnish and deliver all items or perform all the services set forth or otherwise identified above and on any continuation sheets for the consideration stated herein. The rights and obligations of the parties to this contract shall be subject to and governed by the following documents: (a) this award/contract, (b) the solicitation, if any, and (c) such provisions, representations, certifications, and specifications, as are attached or incorporated by reference herein. *(Attachments are listed herein)*

18. [ ] SEALED-BID AWARD *(Contractor is not required to sign this document.)* Your bid on Solicitation Number _____, including the additions or changes made by you which additions or changes are set forth in full above, is hereby accepted as to the items listed above and on any condition sheets. This award consummates the contract which consists of the following documents: (a) the Government's solicitation and your bid, and (b) this award/contract. No further contractual document is necessary. (Block 18 should be checked only when awarding a sealed-bid contract.)

19A. NAME AND TITLE OF SIGNER *(Type or print)*
Elizabeth H. Adams
Executive Director
Office for Sponsored Research
Evanston Campus

20A. NAME OF CONTRACTING OFFICER

b6 -1 Per FBI

19B. NAME OF CONTRACTOR
BY _____
*(Signature of person authorized to sign)*

19C. DATE SIGNED: 3/11/15

20B. UNITED STATES OF AMERICA
BY _____
*(Signature of Contracting Officer)*

20C. DATE SIGNED: 02/23/2015 3/16/15

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STANDARD FORM 26 (REV. 3/2013)
Prescribed by GSA - FAR (48 CFR) 53.214(a)

# AWARD/CONTRACT

1. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700) | RATING

| 2. CONTRACT (Proc. Inst. Ident.) NO. | 3. EFFECTIVE DATE | 4. REQUISITON/PURCHASE REQUEST/PROJECT NO. |
|---|---|---|
| DJF-15-1200-K-0001730 | 02/23/2015 | DJF-15-2300-PR-0016673 |

| 5. ISSUED BY | CODE | 6. ADMINISTERED BY (If other than item 5) | CODE |
|---|---|---|---|
| FEDERAL BUREAU OF INVESTIGATION<br>MISSION SUPPORT CONTRACTS UNIT<br>935 PENNSYLVANIA AVE, NW<br>WASHINGTON, DC 20535-0001 | UNIT_CHIEF | MISSION SUPPORT CONTRACTS UNIT<br>935 PENNSYLVANIA AVENUE, NW<br>WASHINGTON, DC 20535-0001 | 1200 |

7. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)

NORTHWESTERN UNIVERSITY
1801 MAPLE AVE.
2ND FLOOR, SUITE 2410
EVANSTON, IL 60201
DUNS: 160079455

CODE: 362167817 FACILITY CODE: 160079455

8. DELIVERY ☐ FOB ORIGIN ☒ OTHER (See below)

9. DISCOUNT FOR PROMPT PAYMENT

NET 30

10. SUBMIT INVOICES (4 copies unless otherwise specified) TO THE ADDRESS SHOWN IN | ITEM G-1 & G-3

| 11. SHIP TO/MARK FOR | CODE | 12. PAYMENT WILL BE MADE BY | CODE |
|---|---|---|---|
| SEE SCHEDULE | | CONTRACTS AND ACQUISTION MANAGEMENT UNIT<br>ATTN: [redacted] / ROOM # CC4<br>2400 SCHUSTER DRIVE<br>CHEVERLY, MD 20781-1211 | 2500 |

b6 -1 Per FBI

13. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION:
☐ 10 U.S.C. 2304(c) ( ) ☐ 41 U.S.C. 3304(a) ( )

14. ACCOUNTING AND APPROPRIATION DATA
See Lines

| 15A. ITEM NO. | 15B. SUPPLIES/SERVICES | 15C. QUANTITY | 15D. UNIT | 15E. UNIT PRICE | 15F. AMOUNT |
|---|---|---|---|---|---|
| 0001 | CLIN 0001, 0002, 0003<br><br>See Continuation Sheet(s) | 1.000000 | EA | $1,036,987.0000 | $1,036,987.00 |
| | | | | 15G. TOTAL AMOUNT OF CONTRACT | $1,924,321.00 |

16. TABLE OF CONTENTS

| (X) | SEC. | DESCRIPTION | PAGE(S) | (X) | SEC. | DESCRIPTION | PAGE(S) |
|---|---|---|---|---|---|---|---|
| | | PART I - THE SCHEDULE | | | | PART II - CONTRACT CLAUSES | |
| | A | SOLICITATION/CONTRACT FORM | | | I | CONTRACT CLAUSES | |
| | B | SUPPLIES OR SERVICES AND PRICES/COSTS | | | | PART III - LIST OF DOCUMENTS, EXHIBITS AND OTHER ATTACH | |
| | C | DESCRIPTION/SPECS./WORK STATEMENT | | | J | LIST OF ATTACHMENTS | |
| | D | PACKAGING AND MARKING | | | | PART IV - REPRESENTATIONS AND INSTRUCTIONS | |
| | E | INSPECTION AND ACCEPTANCE | | | K | REPRESENTATIONS CERTIFICATIONS AND OTHER STATEMENTS OF OFFERORS | |
| | F | DELIVERIES OR PERFORMANCE | | | L | INSTRS., CONDS., AND NOTICES TO OFFERORS | |
| | G | CONTRACT ADMINISTRATION DATA | | | M | EVALUATION FACTORS FOR AWARD | |
| | H | SPECIAL CONTRACT REQUIREMENTS | | | | | |

*CONTRACTING OFFICER WILL COMPLETE ITEM 17 (SEALED-BID OR NEGOTIATED PROCUREMENT) OR 18 (SEALED-BID PROCUREMENT) AS APPLICABLE*

17. ☒ CONTRACTOR'S NEGOTIATED AGREEMENT *(Contractor is required to sign this document and return 1 copies to issuing office)* Contractor agrees to furnish and deliver all items or perform all the services set forth or otherwise identified above and on any continuation sheets for the consideration stated herein. The rights and obligations of the parties to this contract shall be subject to and governed by the following documents: (a) this award/contract, (b) the solicitation, if any, and (c) such provisions, representations, certifications, and specifications, as are attached or incorporated by reference herein. *(Attachments are listed herein)*

18. ☐ SEALED-BID AWARD *(Contractor is not required to sign this document.)* Your bid on Solicitation Number _____, including the additions or changes made by you which additions or changes are set forth in full above, is hereby accepted as to the items listed above and on any condition sheets. This award consummates the contract which consists of the following documents: (a) the Government's solicitation and your bid, and (b) this award/contract. No further contractual document is necessary. (Block 18 should be checked only when awarding a sealed-bid contract.)

19A. NAME AND TITLE OF SIGNER *(Type or print)*

20A. NAME OF CONTRACTING OFFICER
[redacted]

b6 -1 Per FBI

| 19B. NAME OF CONTRACTOR | 19C. DATE SIGNED | 20B. UNITED STATES OF AMERICA | 20C. DATE SIGNED |
|---|---|---|---|
| BY _____<br>*(Signature of person authorized to sign)* | | BY _____<br>*(Signature of Contracting Officer)* | 02/23/2015 |

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**STANDARD FORM 26 (REV. 3/2013)**
Prescribed by GSA - FAR (48 CFR) 53.214(a)

## Table of Contents

**Section B - Supplies or Services and Prices/Costs**

## SCHEDULE OF SUPPLIES/SERVICES

CONTINUATION SHEET

| ITEM NO. | SUPPLIES/SERVICES | QUANTITY | UNIT | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 0002 | **Line Period of Performance:** 02/24/2015 - 02/23/2016<br>Base Period<br>CLIN 0001, 0002, 0003<br>**Line Period of Performance:** 02/24/2016 - 02/23/2017<br>Unexercised Option 1 | 1.000000 | EA | $887,334.0000 | $887,334.00 |
| | | | | TOTAL | $1,924,321.00 |

**FUNDING DETAILS:**

| ITEM NO. | FUNDING LINE | OBLIGATED AMOUNT | ACCOUNTING CODES |
|---|---|---|---|
| 0001 | 2 | $1,036,987.00 | 2014 - SEY2 - 2300 - 2310 - B8 - 1415-RA9767 - - 25102 - - - - - - |
| | | TOTAL: $1,036,987.00 | |

**Section C - Description/Specifications/Statement of Work**

This Section Is Intentionally Left Blank

**Section D - Packaging and Marking**

This Section Is Intentionally Left Blank

**Section E - Inspection and Acceptance**

This Section Is Intentionally Left Blank

**Section F - Deliveries and Performance**

This Section Is Intentionally Left Blank

**Section G - Contract Administration Data**

This Section Is Intentionally Left Blank

**Section H - Special Contract Requirements**

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**Section I - Contract Clauses**

## Clauses By Full Text

1 Terms and Conditions

Reference Attachment 1 - NW BIC Contract for Sections B-J of contract.

## Section J - List of Attachments

| Identifier | Title | Number of Pages |
|---|---|---|
| 1 | NW BIC Contract | 15 |
| 2 | Attachment A - Tech & Managment Proposal | 24 |
| 3 | Attachment B - Cost Proposal | 10 |
| 4 | Attachment C - FBI IRB Form | 8 |
| 5 | Attachment D - BIC Monthly Financial Status Report Form | 1 |
| 6 | Attachment E - BIC Monthly Technical Status Report Form | 1 |

# AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

| 1. CONTRACT ID CODE | |
|---|---|
| DJF-15-1200-K-0001730 | |

| 2. AMENDMENT/MODIFICATION NO. | 3. EFFECTIVE DATE | 4. REQUISITION/PURCHASE REQ. NO. | 5. PROJECT NO. (If applicable) |
|---|---|---|---|
| 0005 | 09/14/2016 | See Lines | |

| 6. ISSUED BY | CODE | 7. ADMINISTERED BY (If other than Item 6) | CODE |
|---|---|---|---|
| UNIT_CHIEF | | | 1200 |

FEDERAL BUREAU OF INVESTIGATION
MISSION SUPPORT CONTRACTS UNIT
935 PENNSYLVANIA AVE, NW
WASHINGTON, DC 20535-0001

MISSION SUPPORT CONTRACTS UNIT
935 PENNSYLVANIA AVENUE, NW
WASHINGTON, DC 20535-0001

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, state and ZIP Code)

NORTHWESTERN UNIVERSITY
1801 MAPLE AVE.
2ND FLOOR, SUITE 2410
EVANSTON, IL 60201
DUNS: 160078455

CODE: 362167817 FACILITY CODE: 160079455

(X) | 9A. AMENDMENT OF SOLICITATION NO.:

9B. DATED (SEE ITEM 11)

X | 10A. MODIFICATION OF CONTRACT/ORDER NO.: DJF-15-1200-K-0001730

10B. DATED (SEE ITEM 13): 02/23/2015

## 11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

FBI-2014-2015-SBY2-2300-2310-B8-B9-1415-RA9767-25102-WMD-2014

## 13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

| CHECK ONE | |
|---|---|
| | A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A. |
| X | B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b). |
| | C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF: |
| | D. OTHER (Specify type of modification and authority) |

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

The modification serves to de-obligate funding from the Northwestern University BIA IARPA Purchase Order in the amount of $0.54 (PO# DJF-15-1200-K-0001730), from Line #3

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

| 15A. NAME AND TITLE OF SIGNER (Type or print) | 16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) |
|---|---|
| Kelly M. Hilton, Director, OSMD | b6 -1 Per FBI |
| 15B. CONTRACTOR/OFFEROR | 15C. DATE SIGNED |
| (Signature of person authorized to sign) | 9/20/16 |
| 16B. UNITED STATES OF AMERICA | 16C. DATE SIGNED |
| By (Signature of Contracting Officer) | 09/15/2016 |

NSN 7540-01-152-8070
Previous edition unusable

STANDARD FORM 30 (REV. 10-83)
Prescribed by GSA FAR (48 CFR) 53.243

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## Section B - Supplies or Services and Prices/Costs

### SCHEDULE OF SUPPLIES/SERVICES

CONTINUATION SHEET

| ITEM NO. | SUPPLIES/SERVICES | QUANTITY | UNIT | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 0001 | CLIN 0001, 0002, 0003<br>**Line Period of Performance:** 02/24/2015 - 04/30/2016<br>Base Period | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$1,036,987.0000<br>Change: $0.0000<br>Current:<br>$1,036,987.0000 | Previous:$1,036,987.00<br>Change: $0.00<br>Current: $1,036,987.00 |
| 0002 | CLIN 0001, 0002, 0003<br>**Line Period of Performance:** 02/24/2016 - 02/23/2017<br>Unexercised Option 1 | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$887,334.0000<br>Change: $0.0000<br>Current:<br>$887,334.0000 | Previous:$887,334.00<br>Change: $0.00<br>Current: $887,334.00 |
| 0003 | ODC's - Shipping<br>**Line Period of Performance:** 02/24/2015 - 04/30/2016<br>Base Period | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$200.0000<br>Change:<br>($0.5400)<br>Current:<br>$199.4600 | Previous:$200.00<br>Change: ($0.54)<br>Current: $199.46 |
| 0004 | CLIN 0001, 0002, 0003<br>**Line Period of Performance:** 11/01/2015 - 04/30/2016<br>Base Period | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$132,618.0000<br>Change: $0.0000<br>Current:<br>$132,618.0000 | Previous:$132,618.00<br>Change: $0.00<br>Current: $132,618.00 |
| | | | | PREVIOUS TOTAL<br>CHANGE<br>CURRENT TOTAL | $2,057,139.00<br>($0.54)<br>$2,057,138.46 |

**FUNDING DETAILS:**

| ITEM NO. | FUNDING LINE | OBLIGATED AMOUNT | ACCOUNTING CODES |
|---|---|---|---|
| 0001 | 2 | Previous.: $1,036,987.00<br>Change: $0.00 | 2014 - SEY2 - 2300 - 2310 - B8 - 1415-RA9767 - - 25102 - - - - - - |

| | | | |
|---|---|---|---|
| | | Current : $1,036,987.00 | |
| 0003 | 1 | Previous : $200.00<br>Change: ($0.54)<br>Current : $199.46 | 2014 - SEY2 - 2300 - 2310 - B8 - 1415-RA9767 - - 25102 - - - - - - |
| 0004 | 2 | Previous : $132,618.00<br>Change: $0.00<br>Current : $132,618.00 | 2015 - SEY2 - 2300 - 2310 - B8 - 1516-RA9767 - - 25102 - - - - - - |
| | | PREVIOUS: $1,169,805.00<br>CHANGE: ($0.54)<br>CURRENT: $1,169,804.46 | |

**Section C - Description/Specifications/Statement of Work**

**No Clauses**

**Section D - Packaging and Marking**

**No Clauses**

**Section E - Inspection and Acceptance**

**No Clauses**

**Section F - Deliveries and Performance**

**No Clauses**

**Section G - Contract Administration Data**

**No Clauses**

**Section H - Special Contract Requirements**

**No Clauses**

**Section I - Contract Clauses**

## Clauses By Full Text

1 Terms and Conditions

Reference Attachment 1 - NW BIC Contract for Sections B-J of contract.

**Section J - List of Attachments**

**No Clauses**

| Identifier | Title | Number of Pages |
|---|---|---|
| 1 | NW BIC Contract | 15 |
| 2 | Attachment A - Tech & Managment Proposal | 24 |
| 3 | Attachment B - Cost Proposal | 10 |
| 4 | Attachment C - FBI IRB Form | 8 |
| 5 | Attachment D - BIC Monthly Financial Status Report Form | 1 |
| 6 | Attachment E - BIC Monthly Technical Status Report Form | 1 |
| 7 | De-scoped SOW_11.23.15 | |
| 8 | De-scoped Cost Proposal_11.23.15 | |

# AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

| 1. CONTRACT ID CODE | |
|---|---|
| DJF-15-1200-K-0001730 | |

| 2. AMENDMENT/MODIFICATION NO. | 3. EFFECTIVE DATE | 4. REQUISITION/PURCHASE REQ. NO. | 5. PROJECT NO. (If applicable) |
|---|---|---|---|
| 0004 | 11/23/2015 | DJF-15-2300-PR-0016673 | |

| 6. ISSUED BY | CODE | 7. ADMINISTERED BY (If other than item 6) | CODE |
|---|---|---|---|
| UNIT_CHIEF | | | 1200 |

FEDERAL BUREAU OF INVESTIGATION
MISSION SUPPORT CONTRACTS UNIT
935 PENNSYLVANIA AVE, NW
WASHINGTON, DC 20535-0001

MISSION SUPPORT CONTRACTS UNIT
935 PENNSYLVANIA AVENUE, NW
WASHINGTON, DC 20535-0001

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, state and ZIP Code)

NORTHWESTERN UNIVERSITY
1801 MAPLE AVE.
2ND FLOOR, SUITE 2410
EVANSTON, IL 60201
DUNS: 160078455

CODE: 362167817 FACILITY CODE: 160079455

(X) | 9A. AMENDMENT OF SOLICITATION NO.

9B. DATED (SEE ITEM 11)

X | 10A. MODIFICATION OF CONTRACT/ORDER NO. DJF-15-1200-K-0001730

10B. DATED (SEE ITEM 13) 02/23/2015

## 11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

FBI-2014-2015-SEY2-2300-2310-B8-B9-1415-RA9767-25102-WMD-2014

## 13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

| CHECK ONE | |
|---|---|
| | A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A. |
| | B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b). |
| | C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF: |
| X | D. OTHER (Specify type of modification and authority) FAR 52.243-2 |

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

This modification extends the period of performance to 4/30/2016 and incorporates the mutually agreed upon attached descoped SOW and costs.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)

15B. CONTRACTOR/OFFEROR

KELLY MORRISON
DIRECTOR
OFFICE FOR SPONSORED RESEARCH
EVANSTON CAMPUS

(Signature of person authorized to sign)

15C. DATE SIGNED 1/21/16

16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) b6 -1 Per FBI

16B. UNITED STATES OF AMERICA
By

(Signature of Contracting Officer)

16C. DATE SIGNED 12/29/2015

NSN 7540-01-152-8070
Previous edition unusable

STANDARD FORM 30 (REV. 10-83)
Prescribed by GSA FAR (48 CFR) 53.243

## Table of Contents

**Section B - Supplies or Services and Prices/Costs**

## SCHEDULE OF SUPPLIES/SERVICES

CONTINUATION SHEET

| ITEM NO. | SUPPLIES/SERVICES | QUANTITY | UNIT | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 0001 | CLIN 0001, 0002, 0003<br>Line Period of Performance: 02/24/2015 - 04/30/2016<br>Base Period | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$1,038,987.0000<br>Change: $0.0000<br>Current:<br>$1,038,987.0000 | Previous:$1,038,987.00<br>Change: $0.00<br>Current: $1,038,987.00 |
| 0002 | CLIN 0001, 0002, 0003<br>Line Period of Performance: 02/24/2016 - 02/23/2017<br>Unexercised Option 1 | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$887,334.0000<br>Change: $0.0000<br>Current:<br>$887,334.0000 | Previous:$887,334.00<br>Change: $0.00<br>Current: $887,334.00 |
| 0003 | ODC's - Shipping<br>Line Period of Performance: 02/24/2015 - 04/30/2016<br>Base Period | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$200.0000<br>Change: $0.0000<br>Current:<br>$200.0000 | Previous:$200.00<br>Change: $0.00<br>Current: $200.00 |
| | | | | PREVIOUS TOTAL<br>CHANGE<br>CURRENT TOTAL | $1,924,521.00<br>$0.00<br>$1,924,521.00 |

**FUNDING DETAILS:**

| ITEM NO. | FUNDING LINE | OBLIGATED AMOUNT | ACCOUNTING CODES |
|---|---|---|---|
| 0001 | 2 | Previous : $1,038,987.00<br>Change: $0.00<br>Current : $1,038,987.00 | 2014 - SEY2 - 2300 - 2310 - 88 - 1415-RA9787 - - 25102 - - - - - - |
| 0003 | 1 | Previous : $200.00<br>Change: $0.00<br>Current : $200.00 | 2014 - SEY2 - 2300 - 2310 - 88 - 1415-RA9787 - - 25102 - - - - - - |
| | | PREVIOUS: $1,037,187.00<br>CHANGE: $0.00 | |

CURRENT: $1,037,167.00

**Section C - Description/Specifications/Statement of Work**

**No Clauses**

**Section D - Packaging and Marking**

**No Clauses**

**Section E - Inspection and Acceptance**

**No Clauses**

**Section F - Deliveries and Performance**

**No Clauses**

**Section G - Contract Administration Data**

**No Clauses**

**Section H - Special Contract Requirements**

**No Clauses**

**Section I - Contract Clauses**

Clauses By Full Text

1 Terms and Conditions

Reference Attachment 1 - NW BIC Contract for Sections B-J of contract.

**Section J - List of Attachments**

**No Clauses**

| Identifier | Title | Number of Pages |
|---|---|---|
| 1 | NW BIC Contract | 15 |
| 2 | Attachment A - Tech & Menagment Proposal | 24 |
| 3 | Attachment B - Cost Proposal | 10 |
| 4 | Attachment C - FBI IRB Form | 8 |
| 5 | Attachment D - BIC Monthly Financial Status Report Form | 1 |
| 6 | Attachment E - BIC Monthly Technical Status Report Form | 1 |
| 7 | Northwestern_descoped SOW | |
| 8 | Northwestern_Desoped Cost | |

# AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

| 1. CONTRACT ID CODE | |
|---|---|
| DJF-15-1200-K-0001730 | |

| 2. AMENDMENT/MODIFICATION NO. | 3. EFFECTIVE DATE | 4. REQUISITION/PURCHASE REQ. NO. | 5. PROJECT NO. (If applicable) |
|---|---|---|---|
| 0003 | 03/31/2015 | DJF-15-2300-PR-0016673 | |

| 6. ISSUED BY | CODE | 7. ADMINISTERED BY (If other than item 6) | CODE |
|---|---|---|---|
| UNIT_CHIEF | | | 1200 |

FEDERAL BUREAU OF INVESTIGATION
MISSION SUPPORT CONTRACTS UNIT
935 PENNSYLVANIA AVE, NW
WASHINGTON, DC 20535-0001

MISSION SUPPORT CONTRACTS UNIT
935 PENNSYLVANIA AVENUE, NW
WASHINGTON, DC 20535-0001

8. NAME AND ADDRESS OF CONTRACTOR (No., street, country, state and ZIP Code)

NORTHWESTERN UNIVERSITY
1801 MAPLE AVE.
2ND FLOOR, SUITE 2410
EVANSTON, IL 60201
DUNS: 160079455

CODE: 362167817 FACILITY CODE: 160079455

| (X) | 9A. AMENDMENT OF SOLICITATION NO. |
|---|---|
| | 9B. DATED (SEE ITEM 11) |
| X | 10A. MODIFICATION OF CONTRACT/ORDER NO. DJF-15-1200-K-0001730 |
| | 10B. DATED (SEE ITEM 13) 02/23/2015 |

## 11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

FBI-2014-2015-SEY2-2300-2310-B8-B9-1415-RA9767-25102-WMD-2014

## 13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

| CHECK ONE | |
|---|---|
| | A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A. |
| | B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation data, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b). |
| | C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF: |
| X | D. OTHER (Specify type of modification and authority) 52.243-2 |

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Added funding Line 3 in the amount of $200.00 for Shipping Costs. All other language and costs remain unchanged.

NOTE: MODS 1 & 2 do not exist. System error occurred in processing modification and unable to change modification sequence.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

| 15A. NAME AND TITLE OF SIGNER (Type or print) | 16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) |
|---|---|
| | |
| 15B. CONTRACTOR/OFFEROR | 15C. DATE SIGNED |
| (Signature of person authorized to sign) | 5/20/15 |
| 16B. By | 16C. DATE SIGNED 05/05/2015 |

b6 -1 Per FBI

NSN 7540-01-152-8070
Previous edition unusable

STANDARD FORM 30 (REV. 10-83)
Prescribed by GSA FAR (48 CFR) 53.243

Elizabeth H. Adams
Executive Director
Office for Sponsored Research
Evanston Campus

## Table of Contents

## Section B - Supplies or Services and Prices/Costs

### SCHEDULE OF SUPPLIES/SERVICES

CONTINUATION SHEET

| ITEM NO. | SUPPLIES/SERVICES | QUANTITY | UNIT | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 0001 | CLIN 0001, 0002, 0003<br>**Line Period of Performance:** 02/24/2015 - 02/23/2016<br>Base Period | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$1,036,987.0000<br>Change: $0.0000<br>Current:<br>$1,036,987.0000 | Previous:$1,036,987.00<br>Change: $0.00<br>Current: $1,036,987.00 |
| 0002 | CLIN 0001, 0002, 0003<br>**Line Period of Performance:** 02/24/2016 - 02/23/2017<br>Unexercised Option 1 | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$887,334.0000<br>Change: $0.0000<br>Current:<br>$887,334.0000 | Previous:$887,334.00<br>Change: $0.00<br>Current: $887,334.00 |
| 0003 | ODC's - Shipping<br>**Line Period of Performance:** 02/24/2015 - 02/23/2016<br>Base Period | Previous :<br>Change: 1.000000<br>Current : 1.000000 | EA | Previous:<br>$0.0000<br>Change:<br>$200.0000<br>Current:<br>$200.0000 | Previous:$0.00<br>Change: $200.00<br>Current: $200.00 |
| | | | | PREVIOUS TOTAL<br>CHANGE<br>CURRENT TOTAL | $1,924,321.00<br>$200.00<br>$1,924,521.00 |

**FUNDING DETAILS:**

| | | | |
|---|---|---|---|
| 0001 | 2 | Previous : $1,036,987.00<br>Change: $0.00<br>Current : $1,036,987.00 | 2014 - SEY2 - 2300 - 2310 - B8 - 1415-RA9767 - - 25102 - - - - - - |
| 0003 | 1 | Previous : $0.00<br>Change: $200.00<br>Current : $200.00 | 2014 - SEY2 - 2300 - 2310 - B8 - 1415-RA9767 - - 25102 - - - - - - |
| | | PREVIOUS: $1,036,987.00 | |

| CHANGE: $200.00 |
| --- |
| CURRENT: $1,037,187.00 |

**Section C - Description/Specifications/Statement of Work**

**No Clauses**

**Section D - Packaging and Marking**

**No Clauses**

**Section E - Inspection and Acceptance**

**No Clauses**

**Section F - Deliveries and Performance**

**No Clauses**

**Section G - Contract Administration Data**

**No Clauses**

**Section H - Special Contract Requirements**

**No Clauses**

**Section I - Contract Clauses**

Clauses By Full Text

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Reference Attachment 1 - NW BIC Contract for Sections B-J of contract.

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| 5 | Attachment D - BIC Monthly Financial Status Report Form | 1 |
| 6 | Attachment E - BIC Monthly Technical Status Report Form | 1 |

**Section B – Supplies or Services and Prices/Costs**

**CONTRACT TYPE: COST REIEMBURSABLE-NO FEE**
The estimated costs for this contract are shown below.

| CLIN | Supplies or Services | QTY | Estimated Cost |
|---|---|---|---|
| 0001 | Model Advancement- development of a threat hypothesis by verification and identification of biomarkers | LOT | $ 271,000 |
| 0002 | Biomarker/Bioassay Development- bioinformatics analysis and discovery of biomarker targets using SNA-AuNPs and SERS nanosheet platforms | LOT | $ 1,463,321 |
| 0003 | Model Analysis- cross-correlation of signatures from each hypothetical exposure using a weighted agorithm | LOT | $ 190,000 |
| Total Estimated Cost ..... | | | $ 1,924,321 |

**Section C – Description Specifications/Work Statement**

CLIN 0001 – The contractor shall provide the requisite research & development expertise for threat hypothesis model advancement to include the development of a threat hypothesis by verification and identification of biomarkers in accordance with Attachment (A), Northwestern University Technical Proposal, Task 1 and associated subtasks.

CLIN 0002 – The contractor shall provide the requisite research & development expertise to perform bioinformatics analysis and discovery of biomarker targets using SNA-AuNPs and SERS nanosheet platforms in accordance with Attachment (A), Northwestern University Technical Proposal, Task 2 and associated subtasks.

CLIN 0003 - The contractor shall provide the requisite research & development expertise to perform model analysis through cross-correlation of signatures from each hypothetical exposure using a weighted in accordance with Attachment (A), Northwestern University Technical Proposal, Task 3 and associated subtasks.

**Section D – Packaging and Marking**

CLINS 0001, 0002 & 0003 - All electronic data deliverables shall be delivered virus free. All data submitted via compact disc or other data recording media shall be packaged and marked appropriately for safe delivery to the person or persons designated in Section F.

**Packaging, Marking, and Shipping information for the Test and Evaluation Team (T&E) Deliverables going to Lawrence Livermore National Laboratory (LLNL) as identified in Section F are as follows:**

- The Contractor shall send "Samples" to the government Test & Evaluation (T&E) Team, with concurrent notification via email to the COR and to IARPA PMs. The T&E Team will develop a Bar Coding Cataloging system to track Performer Samples and will confirm with the COR and IARPA that they received "Samples" from the contractor. Samples shall be packaged and stored properly in the shipment to provide for safe and secure delivery. Preferred delivery days are Monday-Wednesday. Contractor shall make every effort to avoid Friday, Saturday, Sunday or holiday arrivals.

- The Contractor shall provide metadata for all biomarkers including the sample type, preservatives used, sample repository location, analytical methods used (e.g., MALDI- MS/MS), and other sample characteristics to uniquely identify sample.

- The shipping address for the T&E Team is"

POC: Dr. Crystal Jaing
B361/R1847
Lawrence Livermore National Laboratory
7000 East Ave.
Livermore, CA 94550
Phone: (925) 424-6574

**Section E – Inspection and Acceptance**

CLIN 0001, 0002 & 0003 - All deliverables hereunder shall be accepted by the COR and Program Managers.

**Section F – Deliveries or Performance**

CLIN 0001 – Within 4 months of contract execution in accordance with Attachment (A), Northwestern University Technical Proposal, Task 1 and associated subtasks, the Contractor shall deliver a Threat hypothesis model to the COR and Program Managers.

CLIN 0002 – Within 24 months of contract execution in accordance with Attachment (A), Northwestern University Technical Proposal, Task 2 and associated subtasks, the Contractor shall deliver a bioinformatics analysis and a list of biomarkers: miRNA and DNA proteins, Biomarker binding and detection with SNA-AuNPs in vitro, and miRNA biomarkers for bacterial infection in mice and detection of anthrax-associated signature with SERS nanosheets to the COR and Program Managers.

CLIN 0003 – Within 24 months of contract execution in accordance with Attachment (A), Northwestern University Technical Proposal, Task 3 and associated subtasks, the Contractor shall deliver a final report on the model analysis and cross-correlations of signatures to the COR and Program Managers.

CLINs 0001 – 0003 – The Contractor shall provide a Monthly Status Report (MSR) to include Technical and Financial information to the COR and Program Managers by the 15th of each month. The financial information shall be provided as detailed in the Attachment (C), BIC Financial Tracker template. The technical information shall be provided as demonstrated in Attachment (D), BIC Monthly Technical Status Report Form. A final status report shall be provided to the COR and Program Managers 26 months after execution of this contract.

In conjunction with CLINs 0001 – 0003 the Contract shall provide the deliverables depicted below to the COR and Program Managers within the time periods identified.

- A biomarker test plan for NW bioassays (a detailed protocol for developing the bioassays and biomarkers of interest).
  **Month 4** (Contractor shall submit to LLNL)
- A threat hypothesis model, detailing the rationale for NW threat hypothesis model that explains the error rate in the threat hypothesis and ties the estimated (or measured) error rates of omni-omic biomarkers to the error rate of the overarching threat hypothesis.
  **Months 4, 24** (Contractor shall submit to LLNL)
- A bioinformatics analysis of biomarkers including miRNA targets, DNA, and proteins and demonstrating NW ability to identify miRNA targets.
  **Months 20** (Contractor shall submit to LLNL)
- Biomarker verification, a list of biomarkers (DNA, miRNA, proteins, chemical targets) that identify a suite of candidate biomarkers that confirm (or refute) the proposed threat hypotheses.
  **Month 20** (Contractor shall submit to LLNL)

- Submit duplicate samples (animal blood, simulated human sweat) with metadata, ROC curves and/or dose-response curves. Include detailed protocols for independent verification by the Government Team.
  **Month 20** (Contractor shall submit to LLNL)
- Submit assays based on SNA-AuNPs and SERS nanosheets.
  **Month 24.** (Contractor shall submit to LLNL)

| List of Deliverables for Contractor to Submit to LLNL | | | | |
|---|---|---|---|---|
| **Performer** | **Threat(s)** | **Bio-sample(s) Month 20** | **Algorithm Development Month 20** | **Bio-assay with protocols Month 24** |
| Northwestern University | Bacterial Simulant. | • Animal blood<br>• Simulated Human sweat | Bioinformatics analysis of biomarkers including miRNA targets, DNA, and proteins. | Assay based on SNA-AuNPs and SERS nanosheets |

**Section G – Contract Administration Data**

**G-1 Government Representatives for this contract:**

**Contract Officer (CO):** [redacted] b6 -1 per FBI
**Contracting Officer's Representative (COR):** [redacted]
**FBI Program Manager (FBI-PM):** [redacted]
**IARPA Program Manager (IARPA-PM):** Kristen Jordan; kristen.jordan@iarpa.gov

**G-2 Contracting Officer's Representative (COR)**

(a) [redacted] is hereby designated to act as Contracting Officer's Representative (COR) under this contract. b6 -1 per FBI

(b) The COR is responsible, as applicable, for: receiving all deliverables, inspecting and accepting the supplies or services provided hereunder in accordance with the terms and conditions of this contract; providing direction to the contractor which clarifies the contract effort, fills in details or otherwise serves to accomplish the contractual Scope of Work; evaluating performance; and certifying all invoices/vouchers for acceptance of the supplies or services furnished for payment.

(c) The COR does not have the authority to alter the contractor's obligations under the contract, and/or modify any of the expressed terms, conditions, specifications, or cost of the agreement. If as a result of technical discussions it is desirable to alter/change contractual obligations or the Scope of Work, the Contracting Officer shall issue such changes.

**G-3 Invoice and Payment**

Invoicing:

(a) Invoices shall be submitted to the COR designated in this contract by the 15th of each month.

The invoice shall include the following information:

- Name and address of the Contractor
- Invoice date and invoice number. Invoice numbering should begin at 01 and be consecutively numbered thereafter. (The Contractor should date invoices as close as possible to the date of mailing or transmission.)
- Contract number and contract line item number
- Name, title, and phone number of person to notify in event of defective invoice
- Electronic Funds Transfer (ETF) banking information
- Taxpayer Identification Number (TIN).

(b) The Contractor shall include this information on every invoice when invoicing for full or partial supplies/services delivered/performed. In addition an invoice or receipt for any approved contractor or subcontractor acquired property with an acquisition cost of $5,000 or higher must be included in the invoice for payment. If an invoice does not contain the above information, the Government reserves the right to reject the invoice(s) as IMPROPER and notify the Contractor within seven (7) calendar days after receipt of the invoice at the designated billing office pursuant. (Resubmission of a PROPER invoice(s) will be required).

**Payment:**

(a) Payment under this contract shall be in accordance with FAR 52.216-7, Alternate II Allowable Cost and Payment, as prescribed for contracts with educational institutions.

(b) This contract will be incrementally funded and is subject to FAR 52.323-18 AVAILABILITY OF FUNDS and 52.232-22 LIMITATION OF FUNDS (APR 1984)

**Section H—Special Contracts Requirements**

**H-I 52.232-22 LIMITATION OF FUNDS (APR 1984)**

(a) The parties estimate that performance of this contract will not cost the Government more than

(1) the estimated cost specified in the Schedule or,

(2) if this is a cost-sharing contract, the Government's share of the estimated cost specified in the Schedule.

The Contractor agrees to use its best efforts to perform the work specified in the Schedule and all obligations under this contract within the estimated cost, which, if this is a cost-sharing contract, includes both the Government's and the Contractor's share of the cost.

(b) The Schedule specifies the amount presently available for payment by the Government and allotted to this contract, the items covered, the Government's share of the cost if this is a cost-sharing contract, and the period of performance it is estimated the allotted amount will cover. The parties contemplate that the Government will allot additional funds incrementally to the contract up to the full estimated cost to the Government specified in the Schedule, exclusive of any fee. The Contractor agrees to perform, or have performed, work on the contract up to the point at which the total amount paid and payable by the Government under the contract approximates but does not exceed the total amount actually allotted by the Government to the contract.

(c) The Contractor shall notify the Contracting Officer in writing whenever it has reason to believe that the costs it expects to incur under this contract in the next 60 days, when added to all costs previously incurred, will exceed 75 percent of

(1) the total amount so far allotted to the contract by the Government or,

(2) if this is a cost-sharing contract, the amount then allotted to the contract by the Government plus the Contractor's corresponding share.

The notice shall state the estimated amount of additional funds required to continue performance for the period specified in the Schedule.

(d) Sixty days before the end of the period specified in the Schedule, the Contractor shall notify the Contracting Officer in writing of the estimated amount of additional funds, if any, required to continue timely performance under the contract or for any further period specified in the Schedule or otherwise agreed upon, and when the funds will be required.

(e) If, after notification, additional funds are not allotted by the end of the period specified in the Schedule or another agreed-upon date, upon the Contractor's written request the Contracting Officer will terminate this contract on that date in accordance with the provisions of the Termination clause of this contract. If the Contractor estimates that the funds available will allow it to continue to discharge its obligations beyond that date, it may specify a later date in its request, and the Contracting Officer may terminate this contract on that later date.

(f) Except as required by other provisions of this contract, specifically citing and stated to be an exception to this clause --

(1) The Government is not obligated to reimburse the Contractor for costs incurred in excess of the total amount allotted by the Government to this contract; and

(2) The Contractor is not obligated to continue performance under this contract (including actions under the Termination clause of this contract) or otherwise incur costs in excess of --

(i) The amount then allotted to the contract by the Government or;

(ii) If this is a cost-sharing contract, the amount then allotted by the Government to the contract plus the Contractor's corresponding share, until the Contracting Officer notifies the Contractor in writing that

the amount allotted by the Government has been increased and specifies an increased amount, which shall then constitute the total amount allotted by the Government to this contract.

(g) The estimated cost shall be increased to the extent that

(1) the amount allotted by the Government or,

(2) if this is a cost-sharing contract, the amount then allotted by the Government to the contract plus the Contractor's corresponding share, exceeds the estimated cost specified in the Schedule.

If this is a cost-sharing contract, the increase shall be allocated in accordance with the formula specified in the Schedule.

(h) No notice, communication, or representation in any form other than that specified in subparagraph (f)(2) above, or from any person other than the Contracting Officer, shall affect the amount allotted by the Government to this contract. In the absence of the specified notice, the Government is not obligated to reimburse the Contractor for any costs in excess of the total amount allotted by the Government to this contract, whether incurred during the course of the contract or as a result of termination.

(i) When and to the extent that the amount allotted by the Government to the contract is increased, any costs the Contractor incurs before the increase that are in excess of --

(1) The amount previously allotted by the Government or;

(2) If this is a cost-sharing contract, the amount previously allotted by the Government to the contract plus the Contractor's corresponding share, shall be allowable to the same extent as if incurred afterward, unless the Contracting Officer issues a termination or other notice and directs that the increase is solely to cover termination or other specified expenses.

(j) Change orders shall not be considered an authorization to exceed the amount allotted by the Government specified in the Schedule, unless they contain a statement increasing the amount allotted.

(k) Nothing in this clause shall affect the right of the Government to terminate this contract. If this contract is terminated, the Government and the Contractor shall negotiate an equitable distribution of all property produced or purchased under the contract, based upon the share of costs incurred by each.

(l) If the Government does not allot sufficient funds to allow completion of the work, the Contractor is entitled to a percentage of the fee specified in the Schedule equaling the percentage of completion of the work contemplated by this contract.

**H-2 Order of Precedence**

In case of a conflict between the Contract and Proposal, the Contract shall govern.

**H-3 CONTRACTOR FURNISHED EQUIPMENT (CFE)**

In performance of this contract, the Contractor is authorized to purchase all equipment with an acquisition cost less than $5,000 necessary for project performance. Non-consumable property

purchased hereunder will be tracked and maintained in the Contractor's property system. All capital equipment purchases having an acquisition cost of $5,000 or above shall be reported to the COR and Program Managers on a monthly basis. Invoices for capital items over $50,000 must be provided to the Program Managers on a monthly basis. In accordance with FAR 52-245.1 Alt II, equipment, supplies and materials having a unit acquisition cost of less than $5,000 shall vest in the Contractor upon acquisition or as soon thereafter as feasible; provided that the Contractor obtained the Contracting Officer's approval before each acquisition. Title to property purchased having a unit acquisition cost of $5,000 or more shall vest with the Government. The Contractor shall include a list of all purchased property in the Monthly Status Report segregated by "Contractor Vested" and "Government Vested". The Government will issue final disposition instructions for "Government Vested" CFE at the conclusion of this contract.

**H-4 PUBLICATION AND PRESENTATION**

Publication of results of the research project is encouraged as an important method of recording and reporting scientific information. The contractor shall acknowledge IARPA support by ensuring the following statement is included on all reports and publications of results:

> "Supported by the Intelligence Advanced Research Projects Activity (IARPA) under the BIC Program. The U.S. Government is authorized to reproduce and distribute reprints for Government purposes notwithstanding any copyright annotation thereon. Disclaimer: The views and conclusions contained herein are those of the authors and should not be interpreted as necessary representing the official policies or endorsements, either expressed or implied, of IARPA or the U.S. Government."

One courtesy copy of all BIC-related publications, presentations, press releases, advertisements, and other public announcements will be submitted in soft copy format to the IARPA Program Manager at least 15 days prior to the publication date, for the IARPA pre-publication review process. Such pre-publication review shall be limited to removal of IARPA confidential and proprietary business information and shall not extend to approval of any potential publications. Following publication, one soft copy of each publication shall be submitted to the IARPA Program Manager and Contracting Officer's Representative.

**H-5 KEY PERSONNEL**

Prof. Chad a. Mirkin, Northwestern University
Prof. Ramana Davuluri, Northwestern University
Prof. Shad Thaxton, Northwestern University
Prof. Alan Hauser, Northwestern University

If one or more of the key personnel for whatever reason becomes, or is expected to become unavailable for work under this contract for a continuous period exceeding 30-calendar days, or is expected to devote substantially less effort to the work than indicated in the proposal as initially anticipated, the contractor shall promptly notify the Government Contract Administrator specified in Section G. Upon concurrence of the Contracting Officer or his authorized representative, the contractor shall promptly replace such personnel with personnel of at least substantially equal ability and

qualifications.

All requests for approval of substitutions hereunder must be in writing and provide a detailed explanation of the circumstances necessitating the proposed substitution(s). They must contain a complete resume for the proposed substitute, and any other information requested by the Contracting Officer or needed by him to approve or disapprove the proposed substitution. The Contracting Officer or his authorized representative will evaluate such requests and promptly notify the contractor of the approval or disapproval thereof, in writing.

If the request for approval of substitutions is disapproved, the contract may be subject to termination.

**H-6 EXPORT CONTROL**

The Contractor shall comply with all U.S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the export administration regulations (EAR), 15 CFR parts 730 through 799, in the performance of this contract. In the absence of available license exemptions/exceptions, the Contractor shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of (including deemed exports) hardware, technical data, and software, or for the provision of technical assistance.

The Contractor shall be responsible for obtaining export licenses, if required, before utilizing foreign persons in the performance of this contract, including instances where the work is to be performed on-site at any Government installation (whether in or outside the United States), where the foreign person will have access to export-controlled technologies, including technical data or software.

In the event that export controlled information is required to conduct research under this contract, the Government will so inform Contractor in writing, prior to any such disclosure, and shall not forward or provide any export controlled information without the express written permission of Contractor. Contractor shall have the right to terminate the Agreement if the disclosure of export controlled information under license or otherwise, would jeopardize Contractor's ability to invoke the fundamental research exclusion with regard to the conduct or reporting of its research. In any event, if necessary for the continuation of the research under this Project, upon written notification and subsequent approval, the parties will cooperate to ensure that an appropriate plan is put in place to handle the transfer of any export controlled information.

The Contractor shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.

The Contractor shall appropriately mark all contract deliverables controlled by ITAR and/or EAR.

The Contractor shall be responsible for ensuring that the provisions of this clause apply to its subcontractors.

By signing this contract, the Contractor certifies knowledge of and intended adherence to these requirements.

**H-7 TRAVEL**

Direct travel costs proposed and incurred under this contract shall be limited to the maximum rates set forth in the Federal Travel Regulations (in effect at the time of travel) prescribed by the General Services Administration for travel in the contiguous 48 United States. The Government will reimburse the contractor for the actual transportation fare via the most direct routes (non first class) between place of origin and destination. Video Teleconferences shall be used to the greatest extent possible. Requests for travel on other than "coach" rates shall be submitted to the COR and approved by the Contracting Officer prior to execution of such travel. The Contractor shall receive written approval for all international travel that utilizes BIC Program funding, other than required travel to attend BIC program reviews and for collaboration among team members.

**H-8 INSTITUTIONAL REVIEW BOARD (as applicable)**

In accordance with 45 CFR Part 46, Protection of Human Subjects, aspects of the tasks identified in the Contractor's proposal, Attachment A, shall be subject to review and approval by the Contractor's Institutional Review Board (IRB) and the Federal Bureau of Investigation (FBI) IRB prior to implementation. In addition to the Contractor's IRB protocol, the Contractor shall complete the FBI IRB form, Attachment (B), Pages 1 -4, and submit it to the CO and COR electronically within 30 days of contract award.

**H-9 INTELLECTUAL PROPERTY RIGHTS**

This contract incorporates FAR clauses 52.227-11 and 52.227-14, Alt IV. Furthermore, the Contractor shall provide data in which the Contractor or its teammates have commercial or restricted rights for unlimited use within the BIC program at no additional cost, or, if withholding such data under FAR 52.227-14, Alt IV(g), shall identify the data being withheld and furnish form, fit and function data instead. All Background Intellectual Property brought to the project by either party shall remain the property of the providing party. "Background Intellectual Property" means property and the legal right therein of either or both parties developed before or independent of this contract, including inventions, patent applications, patents, copyrights, trademarks, mask works, trade secrets and any information embodying proprietary data such as technical data and computer software.

- Prior to integrating into any deliverable any commercial, proprietary, restricted, and/or third-party hardware, software, or technical data in which the Contractor or its teammates have commercial or restricted rights, the Contractor shall:
  (a) Inform the Government of any such commercial, proprietary, restricted, and/or third-party hardware, software or technical data;
  (b) Provide information regarding any applicable restrictions on the use, modification, reproduction, release, performance, display, or disclosure of such commercial, proprietary, restricted, and/or third-party hardware, software or technical data and any associated licensing and distribution cost (if any); and
  (c) Obtain the Government's authorization to integrate such commercial, proprietary, restricted, and/or third-party hardware, software, or technical data into any deliverable. The Government may require the Contractor to obtain for the Government, Government Purpose Rights (GPR) in such commercial, proprietary,

restricted, and/or third party hardware, software, or technical data as a condition of such authorization.

- IARPA shall have at a minimum Government Purpose Rights (GPR) for all deliverables.
  (a) Government purpose rights means the rights to use, modify, reproduce, release, perform, display, or disclose technical data and computer software within the Government without restriction; and to release or disclose technical data and computer software outside the Government and authorize persons to whom release or disclosure has been made to use, modify, reproduce, release, perform, display, or disclose that data or software for any United States Government purpose. United States Government purposes include any activity in which the United States Government is a party, including cooperative agreements with international or multi-national defense organizations, or sales or transfers by the United States Government to foreign governments or international organizations.
  (b) Deliverables includes all data, software and tool prototypes, evaluation analyses and documents (such as algorithm flow charts, algorithm parameters, software documentation, methodology documentation, research reports, source code, and publications), presentations, software executables, and sources. Other deliverables include research status reports including waypoint results, tools, and completed prototypes.

**H-10 CONFIDENTIALITY**

Confidential Information refers to any confidential or proprietary information which is transferred from one party to the other under this Agreement, providing the information is transferred in writing and marked as Confidential, or to information which is initially disclosed orally, or in any other non-written form, is identified as confidential at time of disclosure and then summarized in writing and confirmed by the disclosing party as Confidential within thirty (30) days of the initial disclosure. Confidential Information shall not include information which is (i) is known or open to the public or otherwise in the public domain at the time of disclosure; or (ii) becomes part of the public domain after disclosure by any means except through breach of this Agreement by the recipient; or (iii) is already known to the recipient at the time of disclosure; or (iv) is obtained by the recipient from a third party who has a lawful right to disclose it; or (v) is independently developed by recipient without use of disclosing party's Confidential Information as evidenced by recipient's written records; or (vi) is disclosed by a third party not under any known obligation of confidentiality; or (vii) is required to be disclosed by law or statutory regulation or pursuant to a court order

For avoidance of doubt, the data, methods and results of the research generated under this Project shall not be considered Confidential and may be used and published by Contractor

The parties agree that for a period of two (2) years from the termination date of this Agreement they will neither disclose to any third party nor use for any purpose other than the purposes of this Agreement any Confidential Information of the other party unless the disclosing party has given its express written consent. Additionally, each party agrees only to disclose the other party's Confidential Information to those employees, students, affiliates, and/or agents, as necessary to facilitate the performance of obligations under this Agreement.

**H.11 LIABILITY AND NEGATION OF WARRANTY**

Each party shall be liable for any gross negligence or willful misconduct of that party, its employees, agents, officers or anyone acting on behalf of that party.

Contractor makes no representation other than those specified in this Agreement. CONTRACTOR MAKES NO EXPRESS OR IMPLIED WARRANTIES INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OF DATA OR TECHNICAL INFORMATION DERIVED FROM THIS RESEARCH PROJECT OR OF ANY TANGIBLE OR INTANGIBLE PROPERTY OR PROPERTY RIGHT.

Except for confidentiality obligations set forth herein, to the maximum extent permitted by law, in no event will either party be responsible for any incidental, consequential, indirect, special, punitive, or exemplary damages of any kind, lost goodwill, lost profits, lost business or other indirect economic damages, whether such claim is based on contract, negligence, tort (including strict liability) or other legal theory, regardless of whether such party was advised or had reason to know of the possibility of such damages in advance.

**Section I – Contract Clauses**

**52.252-2** -- Clauses Incorporated by Reference (Feb 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available.

52.202-1 DEFINITIONS (NOV 2013)
52.203-3 GRATUITIES (APR 1984)
52.203-5 COVENANT AGAINST CONTINGENT FEES (MAY 2014)
52.203-7 ANTI-KICKBACK PROCEDURES (MAY 2014)
52.203-8 CANCELLATION, RESCISSION, AND RECOVERY OF FUNDS FOR ILLEGAL OR IMPROPER ACTIVITY (MAY 2014)
52.203-10 PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (MAY 2014)
52.203-12 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (OCT 2010)
52.203-13 CONTRACTOR CODE OF BUSINESS ETHICS AND CONDUCT (APR 2010)
52.203-14 DISPLAY OF HOTLINE POSTER(S) (DEC 2007))
52.203-17 CONTRACTOR EMPLOYEE WHISTLEBLOWER RIGHTS AND REQUIREMENT TO INFORM EMPLOYEES OF WHISTLEBLOWER RIGHTS (APR 2014)
52.204-04 PRINTED OR COPIED DOUBLE-SIDED ON POSTCONSUMER FIBER CONTENT PAPER (MAY 2011)
52.204-10 REPORTING EXECUTIVE COMPENSATION AND FIRST-TIER SUBCONTRACT AWARDS (JUL 2013)
52.204-12 DATA UNIVERSAL NUMBERING SYSTEM NUMBER MAINTENANCE (DEC 2012)
52.204-13 SYSTEM FOR AWARD MANAGEMENT MAINTENANCE.(JUL 2013)
52.209-6 PROTECTING THE GOVERNMENT'S INTEREST WHEN SUBCONTRACTING WITH CONTRACTORS DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT (AUG 2013)
52.209-9 UPDATES OF PUBLICLY AVAILABLE INFORMATION REGARDING RESPONSIBILITY MATTERS (JUL 2013)
52.209-10 PROHIBITION ON CONTRACTING WITH INVERTED DOMESTIC CORPORATIONS (MAY 2012)
52.210-1 MARKET RESEARCH (APR 2011)
52.215-2 AUDIT AND RECORDS—NEGOTIATION (OCT 2010)) *Alternate II (Apr 1998)*

52.215-11 PRICE REDUCTION FOR DEFECTIVE CERTIFIED COST OR PRICING DATA—MODIFICATIONS (AUG 2011)
52.215-13 SUBCONTRACTOR CERTIFIED COST OR PRICING DATA—MODIFICATIONS (OCT 2010)
52.215-15 PENSION ADJUSTMENTS AND ASSET REVERSIONS (OCT 2010))
52.215- 21 REQUIREMENTS FOR CERTIFIED COST OR PRICING DATA AND DATA OTHER THAN CERTIFIED COST OR PRICING DATA—MODIFICATIONS (OCT 2010)
52.215-23 LIMITATIONS ON PASS-THROUGH CHARGES (OCT 2009) *Alternate I (Oct 2009).*
52.216-7 ALLOWABLE COST AND PAYMENT (JUN 2013) *Alternate II (Aug 2012)*
52.216-11 COST CONTRACT—NO FEE (APR 1984) *Alternate I (Apr 1984)*
52.216-15 PREDETERMINED INDIRECT COST RATES (APR 1998)
52.216-23 EXECUTION AND COMMENCEMENT OF WORK (APR 1984)
52.216-24 LIMITATION OF GOVERNMENT LIABILITY (APR 1984)
52.216-25 CONTRACT DEFINITIZATION (OCT 2010)
52.216-26 PAYMENTS OF ALLOWABLE COSTS BEFORE DEFINITIZATION (DEC 2002)
52.219-8 UTILIZATION OF SMALL BUSINESS CONCERNS (MAY 2014)
52.219-28 POST-AWARD SMALL BUSINESS PROGRAM REREPRESENTATION (JUL 2013)
52.222-02 PAYMENT FOR OVERTIME PREMIUMS (JULY 1990)
52.222-03 CONVICT LABOR (JUNE 2003)
52.222-21 PROHIBITION OF SEGREGATED FACILITIES (FEB 1999)
52.222-26 EQUAL OPPORTUNITY (MAR 2007)
52.222-35 EQUAL OPPORTUNITY FOR VETERANS (JUL 2014)
52.222-36 EQUAL OPPORTUNITY FOR WORKERS WITH DISABILITIES (JUL 2014)
52.222-37 EMPLOYMENT REPORTS ON VETERANS (JUL 2014)
52.222-40 NOTIFICATION OF EMPLOYEE RIGHTS UNDER THENATIONAL LABOR RELATIONS ACT (DEC 2010)
52.222-50 COMBATING TRAFFICKING IN PERSONS (FEB 2009)
52.222-54 EMPLOYMENT ELIGIBILITY VERIFICATION (AUG 2013)
52.223-06 DRUG-FREE WORKPLACE (MAY 2001)
52.223-18 ENCOURAGING CONTRACTOR POLICIES TO BAN TEXT MESSAGING WHILE DRIVING (AUG 2011)
52.225-13 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (JUNE 2008)
52.227-1 AUTHORIZATION AND CONSENT (DEC 2007) *Alternate I (Apr 1984)*
52.227-11 PATENT RIGHTS—OWNERSHIP BY THE CONTRACTOR (MAY 2014)
52.227-14 RIGHTS IN DATA—GENERAL (MAY 2014) *Alternate IV (Dec 2007)*
52.228-07 INSURANCE -- LIABILITY TO THIRD PERSONS (MAR 1996)
52.230-05 COST ACCOUNTING STANDARDS—EDUCATIONAL INSTITUTION (MAY 2014)
52.232-18 AVAILABILITY OF FUNDS (APR 1984)
52.232-22 LIMITATION OF FUNDS (APR 1984)
52.232-23 ASSIGNMENT OF CLAIMS (MAY 2014)
52.232-25 PROMPT PAYMENT (JUL 2013) *Alternate I (Feb 2002)*
52.232-33 PAYMENT BY ELECTRONIC FUNDS TRANSFER-SYSTEM FOR AWARD MANAGEMENT (JUL 2013)
52.232-35 DESIGNATION OF OFFICE FOR GOVERNMENT RECEIPT OF ELECTRONIC FUNDS TRANSFER INFORMATION (JUL 2013)
52.232-39 UNENFORCEABILITY OF UNAUTHORIZED OBLIGATIONS (JUN 2013)
52.233-1 DISPUTES (MAY 2014) *Alternate I (Dec 1991)*
52.233-3 PROTEST AFTER AWARD (AUG 1996) *Alternate I (June 1985)*
52.233-4 APPLICABLE LAW FOR BREACH OF CONTRACT CLAIM (OCT 2004)
52.242-1 NOTICE OF INTENT TO DISALLOW COSTS (APR 1984)

52.242-3 PENALTIES FOR UNALLOWABLE COSTS (MAY 2014)
52.242-4 CERTIFICATION OF FINAL INDIRECT COSTS (JAN 1997)
52.242-13 BANKRUPTCY (JUL 1995)
52.242-15 STOP-WORK ORDER (AUG 1989) *Alternate I (Apr 1984)*
52.243-2 CHANGES -- COST-REIMBURSEMENT (AUG 1987) - ALTERNATE V (APR 1984)
52.243-6 CHANGE ORDER ACCOUNTING (APR 1984)
52.243-7 NOTIFICATION OF CHANGES (APR 1984)
52.244-2 SUBCONTRACTS (OCT 2010) *Alternate I (June 2007)*
52.244-5 COMPETITION IN SUBCONTRACTING (DEC 1996)
52.244-6 SUBCONTRACTS FOR COMMERCIAL ITEMS (JUL 2014)
52.245-1 GOVERNMENT PROPERTY (APR 2012) Alternate II *(Apr 2012)*
52.245-9 USE AND CHARGES (APR 2012)
52.246-9 INSPECTION OF RESEARCH AND DEVELOPMENT (SHORT FORM) (APR 1984)
52.246-23 LIMITATION OF LIABILITY (FEB 1997)
52.247-1 COMMERCIAL BILL OF LADING NOTATIONS (FEB 2006)
52.247-67 SUBMISSION OF TRANSPORTATION DOCUMENTS FOR AUDIT (FEB 2006)
52.249-5 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (EDUCATIONAL AND OTHER NONPROFIT INSTITUTIONS) (SEPT 1996)
52.250-1 INDEMNIFICATION UNDER PUBLIC LAW 85-804 (APR 1984) *Alternate I (Apr 1984)*
52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)
52.252-4 ALTERATIONS IN CONTRACT (APR 1984)
52.253-01 COMPUTER GENERATED FORMS (JAN 1991)

**NOTICE:** The following contract clauses pertinent to this section are hereby incorporated in full text:

**52.247-67 SUBMISSION OF TRANSPORTATION DOCUMENTS FOR AUDIT (FEB 2006)**
(a) The Contractor shall submit to the address identified below, for prepayment audit, transportation documents on which the United States will assume freight charges that were paid— (1) By the Contractor under a cost-reimbursement contract; and (2) By a first-tier subcontractor under a cost-reimbursement subcontract thereunder.
(b) Cost-reimbursement Contractors shall only submit for audit those bills of lading with freight shipment charges exceeding $100. Bills under $100 shall be retained on-site by the Contractor and made available for on-site audits. This exception only applies to freight shipment bills and is not intended to apply to bills and invoices for any other transportation services.
(c) Contractors shall submit the above referenced transportation documents to—
[redacted] or b6 -1 Per FBI
FBI Headquarters
Attn: [redacted]
935 Pennsylvania Ave NW
Washington, DC 20535

**(End of clause)**

**52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)**
This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. Also, the full text of a clause may be accessed electronically at this/these address(es):
http://www.acquisition.gov/far/

**(End of clause)**

**52.252-4 ALTERATIONS IN CONTRACT (APR 1984)**
Portions of this contract are altered as follows:

_____
_____
_____

**(End of clause)**

**Section J - List of Attachments**

(A) Northwestern University Technical Proposal, Biodagnostic Approaches to Human Profiling through Nanomaterial Indicators dated January 22, 2014, Revised November 25, 2014

(B) Northwestern University Cost Proposal – Revised November 25, 2014

(C) IRB Form

(D) BIC Financial Tracker Template

(E) BIC Monthly Technical Status Report Form

**VOLUME 2: COST PROPOSAL**
**DESCOPE 11/10/2015**

**Section 1: Cover Sheet**

| | |
|---|---|
| (1) BAA Number | IARPA-BAA-13-04 |
| (2) IARPA Office | Office of Safe and Secure Operations |
| (3) Lead Organization Submitting Proposal | Northwestern University |
| (4) Type of Business | Other Educational |
| (5) Contractor's Reference Number | None |
| (6) Other Team Members | None |
| (7) Proposal Title | Biodiagnostic Approaches to Human Profiling Through Nanomaterial Indicators |
| (8) Technical Point of Contact | Professor Chad A. Mirkin<br>Department of Chemistry<br>2145 Sheridan Rd, Tech K148<br>Evanston, IL 60208<br>Phone: 847-467-7302<br>Fax: 847-467-5123<br>Email: chadnano@northwestern.edu |
| (9) Administrative Point of Contact | Kelly Morrison<br>Executive Director, Evanston Campus<br>Office for Sponsored Research<br>1801 Maple Ave, 2nd Floor, Ste 2410<br>Evanston, IL 60201-3149<br>Phone: 847-491-3003, Fax: 847-491-4800 Email:<br>OSR-Evanston@northwestern.edu |
| (10) Award Instrument Requested | Grant |
| (11) Places of Performance | Mirkin - Dept of Chemistry,<br>2190 Campus Dr, Ryan Hall 3rd Floor<br>Evanston, IL 60208 |
| | Davuluri - Dept of Preventive Medicine/HBMI, Rubloff 11th Floor<br>Chicago, IL 60611 |
| | Thaxton - Dept of Urology,<br>303 E Chicago Ave, Tarry 16th Floor<br>Chicago, IL 60025 |

| | |
|---|---|
| | Hauser - Depts of Microbiology/Immunology and Medicine<br>303 E Chicago Ave, Morton 4-660<br>Chicago, IL 60611 |
| Total Period of Performance | 2/24/2015-4/30/2016 |
| (12) Total Proposed Cost | $1,169,805 |
| (13) Offeror's Contract Management Agency | None |
| (14) Offeror's Audit Office | Jan Roy-Singh, Associate Director<br>Accounting Services for Research and Sponsored Programs<br>633 Clark St, Crown Center G547<br>Evanston, IL 60208-1112<br>Phone: 847-491-4237<br>Email: j-roy-singh@northwestern.edu |
| (15) Date proposal was Prepared | DESCOPE 11/10/2015 |
| (16) DUNS Number | 160079455 |
| (17) TIN Number | 36-2167817 |
| (18) Cage Code | 39GV5 |
| (19) Proposal Validity Period | n/a |
| (20) Cost Summaries Provided (App G & H) | n/a |
| (21) Size of Business | n/a |

## Section 2: Estimated Cost Breakdown

1. Cost Element Breakdown

| Cost Element Sheet - Northwestern University | | | | |
|---|---|---|---|---|
| **Description:** | **Task 1 2/24/15-6/23/15 COMPLETE** | **Task 2 2/24/15-10/31/15 COMPLETE** | **Task 2 11/01/15-4/30/16 REMAINING** | **TOTAL PROJECT** |
| **Direct Labor** | | b4 per ODNI<br>b6 per ODNI | | |
| Key Personnel: | | | | |
| Mirkin, Chad PI | | | | |
| Thaxton, Shad Co-I | | | | |
| Davuluri, Rama Co-I | | | | |
| Hauser, Alan Co-I | | | | |
| Post Doctoral Associates | | | | |
| Graduate Students | | | | |
| Research Technician | | | | |
| **Total Direct Labor** | 85,068 | 89,683 | 165,861 | 340,612 |
| **Fringe** | 20,036 | 18,794 | 34,258 | 73,088 |
| **Total Labor** | 105,104 | 108,477 | 200,119 | 413,700 |
| | | | | 0 |
| **Materials & Supplies** | 57,917 | 48,196 | 136,500 | 242,613 |
| **Equipment** | | | 0 | 0 |
| **Travel - Domestic** | 2,667 | 2,806 | 4,120 | 9,593 |
| **Other Direct Costs** | | | | 0 |
| Publication Costs | | | 2,000 | 2,000 |
| Mouse Costs | | | 17,345 | 17,345 |
| Core Facilities/Instrument Usage | 4,818 | 10,888 | 34,300 | 50,006 |
| Shipping LLNL | | | 200 | 200 |
| Graduate Student Tuition | 7,955 | 12,154 | 13,416 | 33,525 |
| **Total Direct Costs** | 73,356 | 74,045 | 207,881 | 355,282 |
| | | | | 0 |
| **Indirect Costs** | 92,925 | 92,850 | 215,048 | 400,824 |
| | | | | 0 |
| **Total Cost** | $ 271,386 | $ 275,371 | $ 623,048 | $ 1,169,805 |

2. Total Cost Broken down by Major Task

| Milestone/Task | Cost |
|---|---|
| **1. Model Advancement** | **$271k** |
| Scano-miR validation | $146k |
| Development of threat model | $125k |
| **2. Biomarker Research/Discovery** | **$899k** |
| Sample processing and isolation | $215k |
| Profiling of isolated miRNA | $252k |
| Bioinformatics analysis | $127k |
| Detect DNA and protein signatures | $305k |

2. Summary of Projected Funding Requirements for Remaining 6 Months

| Month | Task 2-Projected Funding Requirements by Month |
|---|---|
| Nov | $ 103,830.00 |
| Dec | $ 103,830.00 |
| Jan | $ 103,830.00 |
| Feb | $ 103,830.00 |
| Mar | $ 103,830.00 |
| Apr | $ 103,898.00 |
| | $ 623,048.00 |

**Detailed Budget Justification – Northwestern University**
**(Remaining Project Period 11/01/2015 - 4/30/2016)**
**A. Direct Labor**
**Key Personnel**

Prof. Chad A. Mirkin will act as PI for the project. He will direct the proposed project studies, committing 0.45 months academic year effort (5%). Prof. Ramana Davuluri will serve as a co-Investigator, committing 0.60 months calendar year effort (5%). He will perform all biostatistical analysis. Prof. Shad Thaxton will act as a co-Investigator, committing 0.60 months calendar year effort (5%). He will contribute his expertise in nanomaterial synthesis and characterization to the validation of the scano-miR system. Thaxton already helped to develop the scano-miR platform for sensitive and specific detection of microRNA biomarkers from human specimens (e.g., blood and tissue). Thaxton will isolate miRNA for analysis and play a significant role in scano-miR assay validation and optimization. Alan Hauser will act as co-Investigator, committing 0.60 months calendar year effort (5%). Prof. Hauser will be responsible for the overall administration and direction of the mouse experiments in which miRNA signatures for bacterial infections will be sought.

**Other Personnel**

Support for two postdoctoral researchers (100% effort) in the Mirkin Group is requested. The postdoctoral researchers will be responsible for carrying out the day-to-day activities of the

project, including biomarker identification, nanomaterials synthesis, optimization and characterization (e.g., SNAs), sample processing and isolation, miRNA profiling, assay development and verification, and analysis. One postdoctoral researcher in the Hauser Group will be assigned to this project at 100% effort and perform the mouse experiments. This postdoc also will contribute to data analysis and interpretation.

Support for four graduate students (each 50% effort) in the Mirkin Group is requested. A fifth senior graduate student leading this project is fully funded on a departmental fellowship. These students will be responsible for carrying out the day-to-day activities of the project, including biomarker identification, nanomaterials synthesis, optimization and characterization (e.g., SNAs), sample processing and isolation, miRNA profiling, assay development and verification, and analysis.

Support for one technician (50% effort) in the Mirkin Group is requested. The technician will be responsible for synthesis and characterization of SNA constructs for use with the scano-miR platform. Job tasks will include synthesis of oligonucleotides, verification of successful oligonucleotide synthesis, synthesis of SNAs using purified oligonucleotides, and characterization of SNA constructs.

**B. Fringe Benefits**

Employee benefits for faculty and postdoctoral associates have been calculated based on the following DHHS approved rates:

- 9/1/15- 8/31/16.... 24.70% (actual)

The benefit rate for graduate students is 2.3%.

**C. Materials & Supplies**

Funds are requested to cover the cost of expendable materials and supplies.

| **Mirkin:** | |
|---|---|
| Consumables | 18,200 |
| Lab hardware | 5,930 |
| Precursors for synth | 15,000 |
| Reagents,Solv,chem | 12,000 |
| Chromatography | 4,800 |
| Biosupplies | 12,000 |
| Microarrays | 59,070 |
| | 127,000 |

| **Hauser:** | |
|---|---|
| Chemical & media | 3,300 |
| Lab Hardware | 2,400 |
| Mouse anesthetics | 1,900 |
| Dissection tools | 1,900 |
| | 9,500 |

Required materials and supplies include consumables, laboratory glass and plasticware, precursors for synthesis of the organic small molecules, nucleic acids, and nanomaterials, SNAs, general chemical reagents, solvents, biological supplies, such as miRNA isolation kits for miRNA purification and qRT-PCR kits for miRNA quantification, general RNase free washing solutions, including Nanopure™ water, phosphate buffer saline and salts; and microarray cover sealers for miRNA hybridization and incubation. Chromatography supports will be used for the purification of products. Microarray slides are needed for identification of specific biomarkers. Supplies are also needed to successfully perform animal studies.

**D. Capital Equipment**

None

**E. Travel**

Funds are requested to cover the cost of transportation, accommodation, and subsistence for travel to workshops and scientific conferences as follows:

| Conference | |
|---|---|
| Airfare (2) | 1,000 |
| Per Diem & Lodging @ $320, 3 day | 1,920 |
| Estimated Registration | 1,200 |
| | $ 4,120 |

**F. Other Direct Costs**

1. **Publication Costs** – Support is requested to cover the cost of publication.

2. **Mouse Costs** – Support is requested for purchase and per diem housing of mice and assumes mouse experiments.

3. **Lab Services expense / Instrument Charges** – Funds are requested for instrument charges incurred by funded individuals in the various re-charge centers at Northwestern.

| **Services** | |
|---|---|
| Imaging/Charaterization | 10,800 |
| Peptide synthesis | 8,500 |
| Bioinformatics Core | 15,000 |
| | 34,300 |

The line items are based on current rates for the most commonly used instruments /services as detailed below.

| Scanning and Transmission Electron | Day | Night | Training | Assistance |
|---|---|---|---|---|
| Hitachi HD-2300 | $50 | $40 | $400/flat | $100 |
| Hitachi H8100 | $25 | $20 | $200/flat | $80 |
| JEM-2100F TEM | $50 | $40 | $400/flat | $100 |
| Hitachi S-4800-II | $45 | $30 | $150/flat | $40 |

| | | | | |
|---|---|---|---|---|
| Hitachi S-3400N | $30 | $20 | $75/flat | $40 |
| LEO 1525 | $35 | $25 | $150/flat | $40 |
| FEI Quanta 600F | $40 | $30 | $150/flat | $40 |
| FEI Helios NanoLab FIB | $50 | $30 | $150/flat | $50 |

| Scanning Force Microscopy (NIFTI) | Day | Night | Training | Assistance |
|---|---|---|---|---|
| Digital AFM | $25 | $20 | $150/flat | $50 |
| Hysitron TriboIndenter | $25 | $20 | $150/flat | $50 |
| JEOL JSPM-5200 SPM | $25 | $20 | $150/flat | $50 |
| NanoInk Nscriptor | $25 | $20 | $150/flat | $50 |
| Nanonics SNOM | $25 | $20 | $150/flat | $50 |
| Veeco BioScope II | $25 | $20 | $150/flat | $50 |

| Surface Science Microscopy (Keck II) | Day | Night | Training | Assistance |
|---|---|---|---|---|
| XPS / ESCA | $39 | $39 | $180/flat | $60 |
| FT-IR | $29 | $29 | $50/flat | $60 |
| Confocal Raman | $35 | $20 | $50/flat | $60 |
| Profilometer | $30 | $30 | $25/flat | $60 |

| Materials Processing & Microfabrication Facility | |
|---|---|
| SUSS MicroTech MABA6 Mask Aligner<br>Quintel Q-4000 Mask Aligner (0.5 μ m)<br>Quintel Q-2000 Mask Aligner<br>Nanomaster NPE4000 Plasma Enhanced CVD<br>Oxford Instruments μP80 Plasma Enhanced CVD | $20/hr |

| IMSERC | |
|---|---|
| NMR | $8-15 / hr |
| Mass Spec (MSD1100) | $4 / sample |
| Mass Spec (other walk up) | $32.50 / hr |
| Mass Spec (low res / staff run) | $26 / sample ($60/hr staff rate) |
| Mass Spec (High Res / User Prepared LCMS) | $32.50 / sample |
| Mass Spec (High Res / User Prepared Bulk LCMS) | $15 / sample (5 sample minimum) |
| Mass Spec (Neat / EI / additional prep required) | $60 / sample |
| Optical SPectroscopy | $8 / hr |
| ICP AES | $26 / hr |
| ICP MS | $32.50 / hr |
| X-Ray Diffraction structure solution | $400 / sample |
| X-Ray Diffraction data collection | $150/sample |
| X-Ray unit cell | $35/ sample |
| Staff time | $60 / hr |

4. **Tuition** – Support is request to cover the cost of graduate student tuition and fees. Tuition is exempt from F&A charges.
   - 9/1/15 – 8/31/16 … $13,416

## H. Indirect Costs

F&A has been calculated based on the following DHHS approved rates:

- 54.5% MTDC 9/01/11-8/31/16 – Predetermined

**VOLUME 2: COST PROPOSAL**
**REVISED 11/26/2014**

**Section 1: Cover Sheet**

| | |
|---|---|
| (1) BAA Number | IARPA-BAA-13-04 |
| (2) IARPA Office | Office of Safe and Secure Operations |
| (3) Lead Organization Submitting Proposal | Northwestern University |
| (4) Type of Business | Other Educational |
| (5) Contractor's Reference Number | none |
| (6) Other Team Members | None |
| (7) Proposal Title | Biodiagnostic Approaches to Human Profiling Through Nanomaterial Indicators |
| (8) Technical Point of Contact | Professor Chad A. Mirkin<br>Department of Chemistry<br>2145 Sheridan Rd, Tech K148<br>Evanston, IL 60208<br>Phone: 847-467-7302<br>Fax: 847-467-5123<br>Email: chadnano@northwestern.edu |
| (9) Administrative Point of Contact | Elizabeth H. Adams<br>Executive Director, Evanston Campus<br>Office for Sponsored Research<br>1801 Maple Ave, 2nd Floor, Ste 2410<br>Evanston, IL 60201-3149<br>Phone: 847-491-3003, Fax: 847-491-4800 Email:<br>OSR-Evanston@northwestern.edu |
| (10) Award Instrument Requested | Grant |
| (11) Places of Performance | Mirkin - Dept of Chemistry,<br>2190 Campus Dr, Ryan Hall 3rd Floor<br>Evanston, IL 60208 |
| | Davuluri - Dept of Preventive Medicine/HBMI, Rubloff 11th Floor<br>Chicago, IL 60611 |
| | Thaxton - Dept of Urology,<br>303 E Chicago Ave, Tarry 16th Floor<br>Chicago, IL 60025 |

| | |
|---|---|
| | Hauser - Depts of Microbiology/Immunology and Medicine<br>303 E Chicago Ave, Morton 4-660<br>Chicago, IL 60611 |
| Period of Performance | 1/01/2015-12/31/2017 |
| (12) Total Proposed Cost | $1,924,321 |
| (13) Offeror's Contract Management Agency | none |
| (14) Offeror's Audit Office | Jan Roy-Singh, Associate Director<br>Accounting Services for Research and Sponsored Programs<br>633 Clark St, Crown Center G547<br>Evanston, IL 60208-1112<br>Phone: 847-491-4237<br>Email: j-roy-singh@northwestern.edu |
| (15) Date proposal was Prepared | 1/22/2014 - **REV 11/25/2014** |
| (16) DUNS Number | 160079455 |
| (17) TIN Number | 36-2167817 |
| (18) Cage Code | 39GV5 |
| (19) Proposal Validity Period | 90 days (2/26/2015) |
| (20) Cost Summaries Provided (App G & H) | Yes |
| (21) Size of Business | n/a |

**Section 2: Estimated Cost Breakdown**

1. Cost Element Breakdown

**Cost Element Sheet - Northwestern University**

| **Description:** | | **Year 1** | **Year 2** | **24-Month Total** |
|---|---|---|---|---|
| **Direct Labor** | | | | |
| Key Personnel: | | | | |
| Mirkin, Chad | PI | | | |
| Thaxton, Shad | Co-I | | | |
| Davuluri, Ramana | Co-I | | | |
| Hauser, Alan | Co-I | | | |
| Post Doctoral Associates | | | | |
| Graduate Students | | | | |
| Research Technician | | | | |
| **Total Direct Labor** | | 343,818 | 299,455 | 643,273 |
| **Fringe** | | 63,602 | 50,614 | 114,216 |
| **Total Labor** | | 407,420 | 350,069 | 757,489 |
| **Materials & Supplies** | | 164,835 | 141,395 | 306,230 |
| **Equipment** | | 0 | 0 | 0 |
| **Travel - Domestic** | | 9,320 | 8,680 | 18,000 |
| **Other Direct Costs** | | | | 0 |
| Publication Costs | | 2,000 | 2,000 | 4,000 |
| Mouse Costs | | 17,345 | 0 | 17,345 |
| Core Facilities/Instrument Usage | | 32,000 | 32,000 | 64,000 |
| Graduate Student Tuition | | 59,126 | 62,082 | 121,208 |
| **Total Direct Costs** | | 284,626 | 246,157 | 530,783 |
| **Indirect Costs** | | 344,941 | 291,108 | 636,049 |
| **Total Cost** | | $1,036,987 | $887,334 | $1,924,321 |

b4 Per ODNI
b6 Per ODNI

2. Total Cost Broken down by Major Task

| Milestone/Task | Cost |
|---|---|
| **1. Model Advancement** | **$271k** |
| Scano-miR validation | $146k |
| Development of threat model | $125k |
| **2. Biomarker Research/Discovery** | **$1,463k** |
| Sample processing and isolation | $351k |
| Profiling of isolated miRNA | $407k |
| Bioinformatics analysis | $210k |
| Detect DNA and protein signatures | $495k |
| **3. Model Analysis** | **$190k** |
| Cross-correlation of signatures | $190k |

3. Major Program Tasks by Fiscal Year

| Milestone/Task | Proposal Periods | | | |
|---|---|---|---|---|
| | 1/1/15-9/30/15 | 10/1/15-9/30/16 | 10/1/16-12/31/16 | Total |
| **1. Model Advancement** | **$271k** | | | **$271k** |
| Scano-miR validation | $146k | | | $146k |
| Development of threat model | $125k | | | $125k |
| **2. Biomarker Research/Discovery** | **$499k** | **$903k** | **$61k** | **$1,463,000** |
| Sample processing and isolation | $148k | $192k | $11K | $351k |
| Profiling of isolated miRNA | $125k | $282k | | $407k |
| Bioinformatics analysis | | $160k | $50k | $210k |
| Detect DNA and protein signatures | $226k | $269k | | $495k |
| **3. Model Analysis** | | **$30k** | **$160k** | **$190k** |
| Cross-correlation of signatures | | $30k | $160k | $190k |

4. Proposed Subcontract: None
   Proposed Equipment purchase: None
   Proposed Consultant Costs: None

5. Proposed Purchase of any Information Technology - none

6. Summary of Projected Funding Requirements by Month

| Months | Projected Funding Requirements by Month |
|---|---|
| 1 | $84,930 |
| 2 | $82,010 |
| 3 | $82,010 |
| 4 | $82,010 |
| 5 | $82,010 |
| 6 | $82,010 |
| 7 | $101,790 |
| 8 | $86,819 |
| 9 | $86,819 |
| 10 | $86,819 |
| 11 | $86,819 |
| 12 | $92,939 |
| 13 | $75,882 |
| 14 | $73,602 |
| 15 | $73,602 |
| 16 | $73,602 |
| 17 | $73,602 |
| 18 | $73,602 |
| 19 | $75,882 |
| 20 | $73,602 |
| 21 | $72,727 |
| 22 | $71,705 |
| 23 | $71,705 |
| 24 | $77,823 |
| | $1,924,321 |

7. The source, nature and amount of industry cost-sharing, if any: None

8. Identification of pricing assumptions: The Northwestern University F&A rate of 54.5% used in this proposal is associated with a grant. If a contract is awarded, the Federal DoD contract rate of 55.5% applied for F&A.

**Detailed Budget Justification – Northwestern University**

**A. Direct Labor**

**Key Personnel**

Prof. Chad A. Mirkin will act as PI for the project. He will direct the proposed project studies, committing 0.45 months academic year effort (5%) and 0.15 months summer effort (5%). Prof. Ramana Davuluri will serve as a co-Investigator, committing 0.60 months calendar year effort (5%). He will perform all biostatistical analysis. Prof. Shad Thaxton will act as a co-Investigator, committing 0.60 months calendar year effort (5%). He will contribute his expertise in nanomaterial synthesis and characterization to the validation of the scano-miR system. Thaxton already helped to develop the scano-miR platform for sensitive and specific detection of microRNA biomarkers from human specimens (e.g., blood and tissue). Thaxton will isolate miRNA for analysis and play a significant role in scano-miR assay validation and optimization. Alan Hauser will act as co-Investigator, committing 0.60 months calendar year effort (5%). Prof. Hauser will be responsible for the overall administration and direction of the mouse experiments in which miRNA signatures for bacterial infections will be sought.

**Other Personnel**

Two postdoctoral researchers in the Mirkin Group will be assigned to this project at 100% effort (12 calendar months). The postdoctoral researchers will be responsible for carrying out the day-to-day activities of the project, including biomarker identification, threat model development, nanomaterials synthesis, optimization, and characterization (e.g., SNAs and nanosheets), sample processing and isolation, miRNA profiling, assay development and verification, and analysis. One postdoctoral researcher in the Hauser Group will be assigned to this project at 100% effort (12 calendar months) and perform the mouse experiments. This person also will contribute to data analysis and interpretation.

Four graduate students in the Mirkin Group will work 100% on this project. These students will be responsible for carrying out the day-to-day activities of the project, including biomarker identification, threat model development, nanomaterials synthesis, optimization, and characterization (e.g., SNAs and nanosheets), sample processing and isolation, miRNA profiling, assay development and verification, and analysis.

One graduate student in the Thaxton Group will work at 50% effort. This graduate student will be responsible for isolating total RNA from serum obtained from patient samples and transferring know-how to Mirkin group members regarding SNA synthesis and microRNA array development.

One technician in the Mirkin Group will work at 50% effort. The technician will be responsible for synthesis and characterization of SNA constructs for use with the scano-miR platform. Job tasks will include synthesis of oligonucleotides, verification of successful oligonucleotide synthesis, synthesis of SNAs using purified oligonucleotides, and characterization of SNA constructs.

**B. Fringe Benefits**

Employee benefits for faculty and postdoctoral associates have been calculated based on the following DHHS approved rates:

- 9/1/14- 8/31/15.... 27.80% (actual)
- 9/1/15- 8/31/16.... 28.00% (estimated)
- 9/1/16- 8/31/17.... 28.20% (estimated)

- 9/1/17- 8/31/18... 28.40% (estimated)
- 9/1/18- 8/31/19... 28.60% & thereafter (estimated)

The benefit rate for graduate students is 2.3% through FY2019.

**C. Materials & Supplies**

Funds are requested to cover the cost of expendable materials and supplies over the two year period.

| Mirkin Materials & Supplies | Project Year 1 | Project Year 2 |
|---|---|---|
| Consumables | $31,000 | $28,000 |
| Laboratory hardware | 10,000 | 7,000 |
| Precursors for synthesis | 47,000 | 47,000 |
| Reagents, Solvents, Chemicals | 5,000 | 5,000 |
| Chromatography supports | 2,000 | 2,000 |
| Biosupplies | 20,000 | 20,000 |
| Microarrays | 8,000 | 8,000 |
| Gasket Slide Kits | 1,200 | 1,200 |
| | $124,200 | $118,200 |
| **Thaxton Materials & Supplies** | | |
| DNA synthesis | $4,000 | $3,600 |
| microRNA isolation | 6,635 | 6,095 |
| T4RNA ligase | 1,000 | 900 |
| MicroRNA arrays (test) | 8,000 | 7,200 |
| SNA probe materials | 6,000 | 5,400 |
| | $25,635 | $23,195 |
| **Hauser Materials & Supplies** | | |
| Chemicals and Media | 5,000 | |
| Laboratory hardware | 4,000 | |
| Mouse anesthetics | 3,000 | |
| Dissection tools | 3,000 | |
| | $15,000 | |

Required materials and supplies include consumables, laboratory glass and plasticware, precursors for synthesis of the organic small molecules, nucleic acids, and nanomaterials, including OWL-based nanostructures, nanosheets, and SNAs, general chemical reagents, solvents, biological supplies, such as mirVana miRNA isolation kits (Ambion) for miRNA purification and TaqMan qRT-PCR kits (TaqMan) for miRNA quantification, general RNase free washing solutions, including Nanopure™ water, phosphate buffer saline and salts, and microarray cover sealers for miRNA hybridization and incubation. Chromatography supports will be used for the purification of products. Identification of specific biomarkers indicative of the biological states of individuals is a critical component for the success of the proposed nanotechnology-based detection platform; microarray chips in addition to hybridization gasket slide kits are needed. Supplies are also needed to successfully perform animal studies.

**D. Capital Equipment**

None

**E. Travel**

Funds are requested to cover the cost of transportation, accommodation, and subsistence for travel to kick-off meetings and projects, workshops, and scientific conferences as follows:

| | |
|---|---|
| Kick-Off Meeting | |
| Airfare (2) | 1,000 |
| Per Diem & Lodging @ $320, 3 days | 1,920 |
| Program Workshop | |
| Airfare (2) | 1,000 |
| Per Diem & Lodging @ $320, 2 days | 1,280 |
| Conference - MRS, Spring 2015 | |
| Airfare (2) | 1,000 |
| Per Diem & Lodging @ $320, 3 days | 1,920 |
| Estimated Registration | 1,200 |
| Program Workshop | |
| Airfare (2) | 1,000 |
| Per Diem & Lodging @ $320, 2 days | 1,280 |
| Program Workshop | |
| Airfare (2) | 1,000 |
| Per Diem & Lodging @ $320, 2 days | 1,280 |
| Conference - MRS, Spring 2016 | |
| Airfare (2) | 1,000 |
| Per Diem & Lodging @ $320, 3 days | 1,920 |
| Estimated Registration | 1,200 |
| | $18,000 |

**F. Other Direct Costs**

1. **Publication Costs** – Support is requested to cover the cost of publication each year for 2 years.

2. **Mouse Costs** – Support is requested for purchase and per diem housing of mice and assumes mouse experiments.

3. **Lab Services expense / Instrument Charges** – Funds are requested for instrument charges incurred by funded individuals in the various re-charge centers at Northwestern for 2 years, including the Bioinformatics Core Facility.

| Core Facilities Instrument Usage Fees | Project Year 1 | Project Year 2 |
|---|---|---|
| Imaging/Characterization | $25,000 | $25,000 |
| Surface Science | 4,000 | 4,000 |
| Microfabrication | 3,000 | 3,000 |
| | $32,000 | $32,000 |

The line items are based on current rates for the most commonly used instruments /services as detailed below.

| Scanning and Transmission Electron | Day | Night | Training | Assistance |
|---|---|---|---|---|
| Hitachi HD-2300 | $50 | $40 | $400/flat | $100 |
| Hitachi H8100 | $25 | $20 | $200/flat | $80 |
| JEM-2100F TEM | $50 | $40 | $400/flat | $100 |
| Hitachi S-4800-II | $45 | $30 | $150/flat | $40 |
| Hitachi S-3400N | $30 | $20 | $75/flat | $40 |
| LEO 1525 | $35 | $25 | $150/flat | $40 |
| FEI Quanta 600F | $40 | $30 | $150/flat | $40 |
| FEI Helios NanoLab FIB | $50 | $30 | $150/flat | $50 |

| Scanning Force Microscopy (NIFTI) | Day | Night | Training | Assistance |
|---|---|---|---|---|
| Digital AFM | $25 | $20 | $150/flat | $50 |
| Hysitron TriboIndenter | $25 | $20 | $150/flat | $50 |
| JEOL JSPM-5200 SPM | $25 | $20 | $150/flat | $50 |
| NanoInk Nscriptor | $25 | $20 | $150/flat | $50 |
| Nanonics SNOM | $25 | $20 | $150/flat | $50 |
| Veeco BioScope II | $25 | $20 | $150/flat | $50 |

| Surface Science Microscopy (Keck II) | Day | Night | Training | Assistance |
|---|---|---|---|---|
| XPS / ESCA | $39 | $39 | $180/flat | $60 |
| FT-IR | $29 | $29 | $50/flat | $60 |
| Confocal Raman | $35 | $20 | $50/flat | $60 |
| Profilometer | $30 | $30 | $25/flat | $60 |

| Materials Processing & Microfabrication Facility | |
|---|---|
| SUSS MicroTech MABA6 Mask Aligner<br>Quintel Q-4000 Mask Aligner (0.5 μ m)<br>Quintel Q-2000 Mask Aligner<br>Nanomaster NPE4000 Plasma Enhanced CVD<br>Oxford Instruments μP80 Plasma Enhanced CVD | $20/hr |

| IMSERC | |
|---|---|
| NMR | $8-15 / hr |
| Mass Spec (MSD1100) | $4 / sample |
| Mass Spec (other-walk up) | $32.50 / hr |
| Mass Spec (low res / staff run) | $26 / sample ($60/hr staff rate) |
| Mass Spec (High Res / User Prepared LCMS) | $32.50 / sample |
| Mass Spec (High Res / User Prepared Bulk LCMS) | $15 / sample (5 sample minimum) |

| | |
|---|---|
| Mass Spec (Neat / EI / additional prep required) | $60 / sample |
| Optical SPectroscopy | $8 / hr |
| ICP AES | $26 / hr |
| ICP MS | $32.50 / hr |
| X-Ray Diffraction structure solution | $400 / sample |
| X-Ray Diffraction data collection | $150/sample |
| X-Ray unit cell | $35/ sample |
| Staff time | $60 / hr |

4. **Tuition** – Support is request to cover the cost of graduate student tuition and fees each year for two years and is inflated 5% each University fiscal year starting in September. Tuition is exempt from F&A charges.

   - 9/1/14 – 8/31/15 … $12,924
   - 9/1/15 – 8/31/16 … $13,570
   - 9/1/16 – 8/31/17 … $14,249

**G. Subaward - None**

**H. Indirect Costs**

F&A has been calculated based on the following DHHS approved rates:

54.5% MTDC 9/01/11-8/31/16 – Predetermined, and thereafter provisional.

Note, the applied rate is for a grant award. If the DOD award instrument is contract, the applicable rate will be 55.5%.

## VOLUME 1 - TECHNICAL AND MANAGEMENT PROPOSAL

### Section 2: Summary of Proposal

Innovative claims for the proposed research. Our goal is to develop the next generation of bioassays by advancing nanotechnology-based components that can be utilized in intelligent and portable lab-on-a-chip technologies. These assays will be based on spherical nucleic acid-gold nanoparticle conjugates (SNA-AuNPs)[1,2] and surface-enhanced Raman scattering (SERS) nanosheets.[3] This approach has significant advantages over state-of-the-art methods because it avoids enzymatic amplification steps, is highly scalable, and has a simple readout mechanism based on the optical properties of metal nanoparticles. A terrorist working to synthesize, manufacture, and use anthrax (as proposed in our threat hypothesis) will exhibit a unique set of biological signatures in their blood and sweat that can be detected with high specificity and sensitivity using these assays. Our threat hypothesis will include biomarkers, such as bacterial DNA, microRNA (miRNA), and proteins synthesized by the bacterium, and chemicals used in the production of anthrax (i.e., sporicides), and spores. Taken together these 'signatures' provide an important balance between agent and environmental exposure defining an individual's involvement in the production, handling, and transport of anthrax. This proposal covering 24 months (phase 1) will put us in a position to identify a biomarker profile for anthrax exposure and develop SNA-AuNPs and SERS nanosheet assays towards a comprehensive anthrax sensor.

Summary of products, technology, and deliverables of the proposed research results. We will develop: 1) A test plan for our bioassays (a detailed protocol for developing the bioassays and biomarkers of interest); 2) A threat hypothesis model, detailing the rationale for our threat hypothesis; 3) A bioinformatics analysis of miRNA targets, demonstrating our ability to identify miRNA targets; 4) A list of biomarkers; 5) A final report.

Schedule and milestones for the proposed research and overall estimates of cost for each task.

| Milestone/Task | Deliverable | Month Completed | Cost |
|---|---|---|---|
| **1. Model Advancement** | | | **$271k** |
| Scano-miR validation | | 4 | $146k |
| Development of threat model | Threat hypothesis model | 4 | $125k |
| **2. Biomarker/Bioassay Development** | | | **$1,463,000** |
| Sample processing and isolation | | 24 | $351k |
| Profiling of isolated miRNA | | 20 | $407k |
| Bioinformatics analysis | Bioinformatics analysis<br>List of biomarkers: miRNA, DNA, proteins | 24 | $210k |
| Detect DNA and protein signatures | Biomarker (DNA, miRNA, protein) binding and detection with SNA-AuNPs *in vitro*, and miRNA biomarkers for bacterial infection (in mice). | 20 | $495k |

| | | | |
|---|---|---|---|
| | Detection of anthrax-associated signatures with SERS nanosheets | | |
| **3. Model Analysis** | | | **$190k** |
| Cross-correlation of signatures | Final Report | 24 | $190k |

Overview of the technical approach and plan. This proposal contains three milestones with unique tasks and subtasks (estimated cost is **$1.92 million** over 2 years). We will complete these milestones: (1) *Model Advancement*-development of our threat hypothesis by verification and identification of biomarkers; (2) *Biomarker Research/Discovery*-bioinformatics analysis and discovery of biomarker targets using SNA-AuNPs and SERS nanosheet platforms; (3) *Model Analysis*–cross-correlation of signatures from each hypothetical exposure using a weighted algorithm that will proportionate the threshold value for each biomarker assay according to our threat hypothesis. In the final report, we will summarize our findings and discuss our strategy to develop a biomarker profile for anthrax.

Related Research. Nanomaterials research has focused on the detection and quantification of biomolecules, and many examples utilize Au nanoparticles.[4,5] Nanoparticles offer almost unlimited scalability, but control over their morphology, functionalization, and interactions is challenging and has been a major focus of nanotechnology research.[6] Mirkin has devoted a considerable amount of time aimed at understanding all of these fundamental properties and has developed nanomaterials-based assays that can compete with, or surpass, the current state-of-the-art bioassays. Mirkin's research has been translated into a variety of commercial FDA-cleared, nanotechnology-based assays via Nanosphere,[7-11] and the group has extensively collaborated with government researchers to develop such assays. We are confident our proposed work will be a successful contribution to the *next generation* of portable bioassays that are sensitive and accurate.

Project Contributors. Mirkin is the PI on this project and he will coordinate the entire effort. Davuluri and Thaxton are Key Personnel. Hauser is a significant contributor. Bios of all of these contributors are included in the Detailed Management Plan. Eight graduate students, postdoctoral fellows, and technicians will carry out the research work described.

| Participants | Organization | Role | Capabilities | Contributions | Time |
|---|---|---|---|---|---|
| Prof. Chad Mirkin | Northwestern | PI | Project Lead | Expertise and oversight | 10% |
| Prof. Ramana Davuluri | Northwestern | Key Personnel | Biostatician | miRNA Bioinformatics | 5% |
| Prof. Shad Thaxton | Northwestern | Key Personnel | Translational Research | miRNA sample sourcing | 5% |
| Prof. Alan Hauser | Northwestern | Significant Contributor | Immunologist | Mouse model, miRNA samples | 5% |

**Section 3: Detailed Proposal Information**

SOW: In this proposal, our threat hypothesis consists of a terrorist working to culture, grow, purify, and weaponize anthrax. This individual will have a unique set of biological signatures

that are simultaneously detectable with our nanotechnology-enabled assays. Anthrax is a complicated and unique threat because it is a bioweapon, which elicits a complex response in its victims, and it involves a relatively complex means of production.[12] We expect signatures from a variety of the different states of weaponized anthrax production will increase the accuracy of our bioassays, so even if no terrorist attack has occurred, individuals who are involved in the production of anthrax could test positive. The first milestone is centered on the development of our threat-hypothesis model and biomarker identification plan (Figure 1). We will develop, in a logical, stepwise manner and building on our existing knowledge base, a way of rapidly and definitively determining whether or not an individual has been exposed to anthrax through identification of biomarkers. We recently developed a novel nanoparticle-based detection platform that potentially could be used to profile the miRNA signatures for both an individual's health and exposure to chemical or biological agents.[7] Our initial work has been in the area of prostate cancer (PCa); we have carried out proof-of-concept scanometric miRNA profiling (scano-miR) of blood samples to differentiate healthy and diseased patients.[7] For those that were determined to have cancer, we also used the assay to discriminate between patients with aggressive or indolent forms. miRNAs are promising biomarkers that can be used to detect a wide variety of diseases since they are tissue- and function-specific.[13] Importantly, the scano-miR platform can be adapted to detect DNA and proteins with comparable sensitivity to that of miRNA detection. Thus, using the scano-miR as a guide (Figures 2 and 3), we will develop assays for DNA, protein, and miRNA signatures of anthrax (*vide infra*). Validation of the scano-miR platform is an important step in developing this technology as a tool for profiling human exposure to chemical and biological threats. We plan to validate this novel nanoscale platform through the use of known synthetic miRNA molecules added to serum samples.

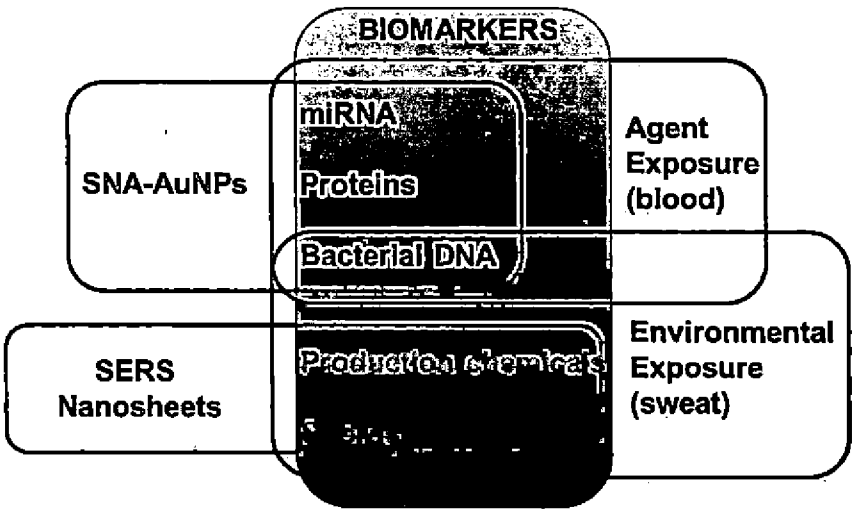


***Figure 1:*** Threat hypothesis graphic model detailing the relationship between our proposed nanoparticles and biomarker identification and verification.

We (Mirkin, Hauser) will simultaneously begin to profile miRNA levels in mice that have been infected with bacteria (e.g., *Acinetobacter baumannii*) to compare miRNA levels from infected and uninfected mice. This task will be done utilizing the same (or optimized) procedure we used previously in our laboratory to determine the PCa miRNA profiles. This way, we can be confident that the miRNA profiles we discover in our mouse model are accurate. Furthermore, because miRNAs are largely conserved, this profile will be the first of its kind connecting miRNA levels to bacterial infections. We will submit a detailed test plan at month 4, which includes the bacteria we will investigate and the mouse model we will use. The exit criteria of this objective will be identification of miRNAs that can be used as biomarkers for bacterial

infection.

We also plan to synthesize SNA-AuNPs that will capture oligonucleotide signatures of bacterial DNA[16] and proteins that are signatures for anthrax toxin.[17,18] The first deliverable associated with this objective will be a definitive list of our bacterial DNA and protein biomarker targets at the end of month four. Once we have identified our targets, we will synthesize the capture oligonucleotide sequences, load these sequences onto optimized Au cores, buy or synthesize the biomarkers, and quantify biomarker binding to the SNA-AuNPs. Mirkin and Thaxton will be responsible for making the constructs and quantifying the binding of the biomarkers using standard assays. The exit criterion of this objective will be the successful binding of our target biomarkers.

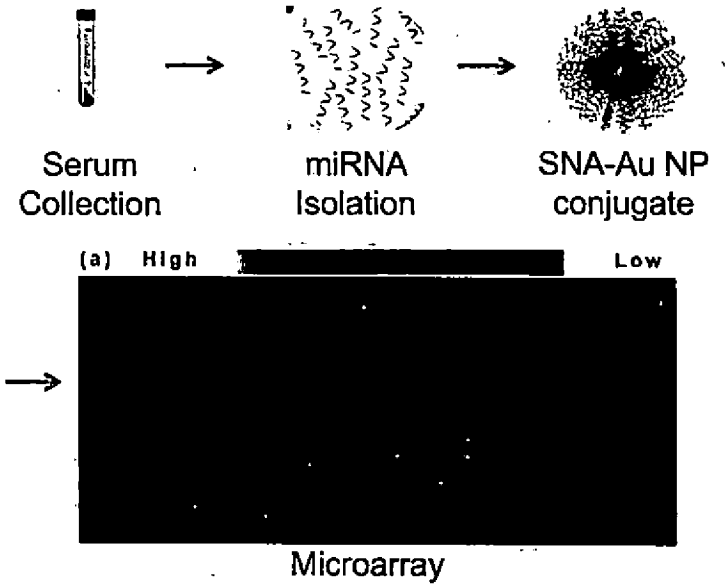


***Figure 2:*** The scano-miR platform. Detection of human serum miRNAs using the scano-miR system was performed after hybridizing recovered miRNAs onto a high-density microarray and recorded using a scanner. Each spot corresponds to a single miRNA and the color corresponds to the miRNA concentrations.

To complement this approach and integrate an alternative set of signatures into our threat model, we (Mirkin) will incorporate nanosheets as a next generation SERS platform for inspecting chemical signatures on microscopic dust, dirt, pollen,

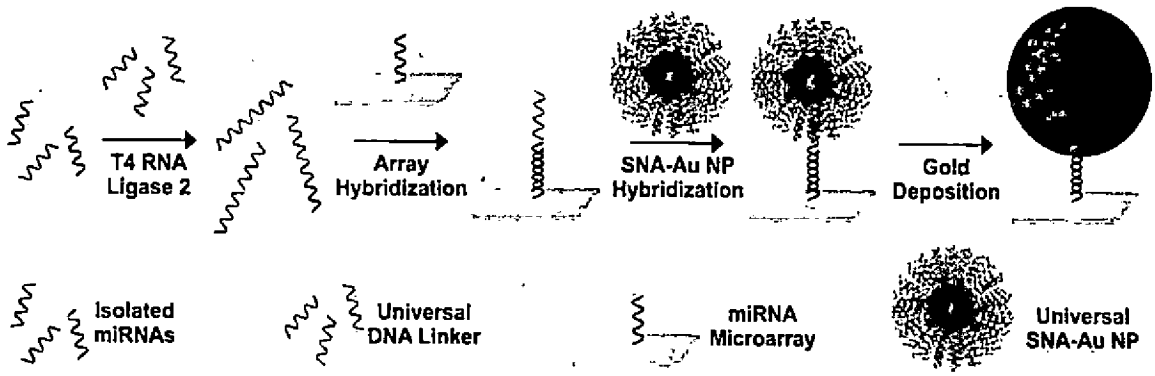


***Figure 3:*** Scheme for the scanometric array-based multiplexed detection of miRNA species (scano-miR). Isolated miRNAs are enzymatically ligated to a universal DNA linker followed by hybridization onto miRNA microarray. After washing unbound miRNA species, universal SNA-functionalized gold nanoparticle conjugates (SNA-Au NPs) are subsequently hybridized to detect captured miRNA targets. Next, signal intensity is amplified by depositing gold with gold enhancing solution (1:1 (v:v) mixture of 1 mM $HAuCl_4$ and 10 mM $NH_2OH$) for 5 min and imaged with a Scanner (LS Reloaded, Tecan, Salzburg, Austria).

and organisms (Figure 4). We will detect signatures associated with the production of weaponized anthrax such as polymyxin-lysozyme-EDTA-thallous acetate (PLET), which is a chemical commonly used to isolate *B. anthracis* in contaminated samples. Nanosheets conform around complex surfaces, maintaining the embedded nanoparticles' relative position in the 'sheet' and locating them in proximity with surfaces rich with chemical information.[3] These nanosheets consist of micron-sized, ultra-thin, and flexible silica sheets interfaced with discrete, highly monodisperse Au nanorod dimers synthesized by on-wire lithography (OWL).[19,20] The thickness of these nanosheets is ~12 nm, the typical edge lengths are 1-4 μm, and the nanorod dimers can range in diameter from 35 to 150 nm. Importantly, they are solution-dispersible and can be easily dispensed onto any surface or remain suspended in solution and interact with soluble analytes. Nanosheets combine enhancing metal nanoparticles with a scaffold that controls their spatial distribution during deployment into complex real-world environments.

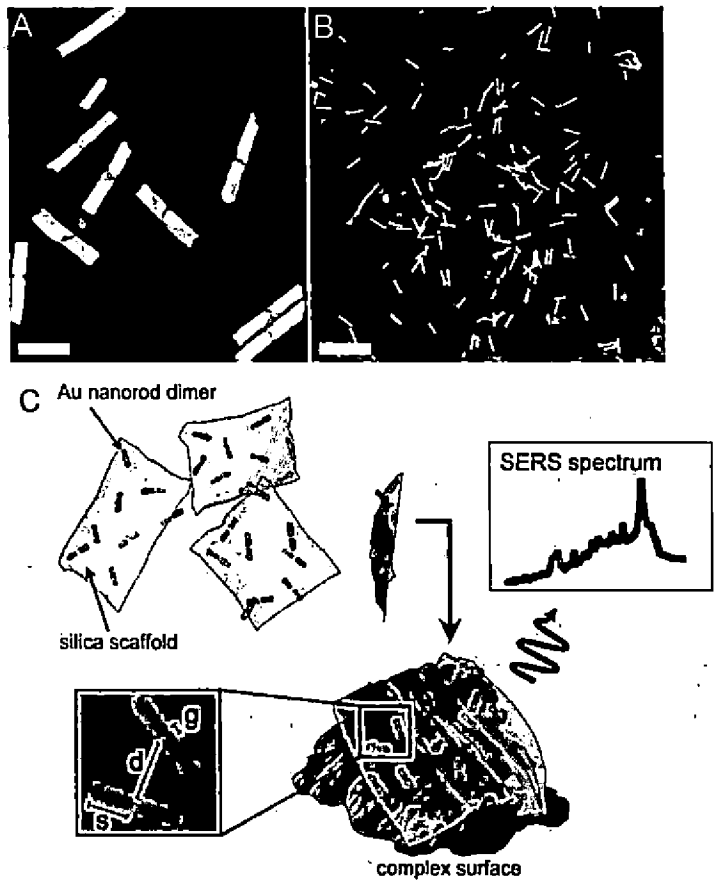


***Figure 4:*** Typical electron microscopy images of nanosheets. (A,B) Images of the nanorod dimers in the nanosheets, showing their morphology and distribution across the silica sheet. Scale bars are equal to 100 nm and 500 nm for (A) and (B). (C) Scheme illustrating how the nanosheets conform to the topography of complex surfaces. The resulting gap size (g), nanorod length (s), and dimer density (d) are maintained and are crucial for high quality SERS data.

At the start of this program, we will optimize the SERS nanosheets for chemical signature detection on micron-sized structures. We will embed three different types of nanoparticles into the sheets at different concentrations (NPs/sheet area). Au nanorod dimers (Figure 4A), concave cubes (Figure 5A), and prisms (Figure 5B) are promising candidates due to their high enhancement factors (EFs $=10^8$) and ease of synthesis.[21,22] We will then functionalize the nanoparticles with 1,4-benzenedithiol (1,4-BDT)[23] and integrate the SERS signal over the entire area of a single sheet using our Raman microprobe system. We will determine the experimental parameters that give the maximum signal. The exit criteria for this objective will be a SERS nanosheet that has a signal >1000 counts per second (CPS) per nanosheet for 1,4-BDT.

As the next part of this objective, we will modify the thickness of the sheets through

control over our deposition parameters. The thickness of the nanosheet can be used as a handle to control its size and robustness. We will engineer the sheets to conform to micron-sized structures without tearing. We will synthesize nanosheets of four thicknesses ranging from 5 to 20 nm, and deposit these sheets on 5 μm diameter silica beads, commercially available spores (similar to anthrax spores in terms of shape and size),[24] and dirt particles. We will then use electron microscopy to determine the structural integrity of the nanosheets. The exit criteria of this objective is the fabrication of nanosheets that: 1) conform to the silica spheres without tearing and 2) have an optimized SERS EF based on NP shape and density. Data, including SERS EFs and images of the sheets will be provided in report form. These objectives and tasks will guide our subsequent studies in using these nanomaterials to detect biomarkers of anthrax.

After the SERS nanosheets are synthesized, we will determine their ability to detect micron-sized particles at concentrations from 100 to 10,000 particles/mL. We will test the nanosheets with micron-sized silica beads doped with unique chemical signatures. We will vary the concentration of the beads in simulated sweat solutions and deposit 10 μL of this solution onto a substrate with the SERS nanosheets. After drying, we will use our Raman system to measure the SERS from the entire sample area (~500 μm in diameter). We will then repeat the above experiment using spores (not from *B. anthracis*) and PLET that we will buy commercially. The exit criterion of this objective is the determination of the ability of the nanosheets to conform around spores and to detect chemical signatures of anthrax production in the presence of confounds (other beads, dirt, pollen, sweat, chemicals). The associated deliverables include successful identification of chemical signatures of anthrax and a detailed protocol of the experimental techniques used in this study.

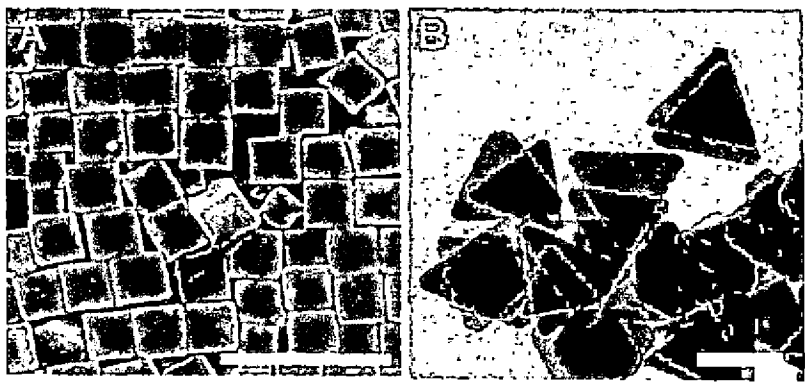


***Figure 5:*** Typical electron microscopy images of concave nanocubes (A) and prisms (B). The scale bars are 500 and 50 nm, respectively.

This proposal deals with identifying novel biomarkers of disease and bioterrorism. Developing actual anthrax assays are not proposed in this phase. However, in the final report, we will discuss our plans to apply the knowledge we have learned from the work conducted in this phase to ultimately develop bioassays for anthrax detection in a later phase. In addition the final report will summarize all of our findings and determine our readiness for the next phase.

| Milestone/Task | Months | | | | | |
|---|---|---|---|---|---|---|
| | 1-4 | 5-8 | 9-12 | 13-16 | 17-20 | 21-24 |
| **1. Model Advancement** | | | | | | |
| Scano-miR validation | | | | | | |
| Development of threat model | | | | | | |
| **2. Biomarker Research/Discovery** | | | | | | |
| Sample processing and isolation | | | | | | |
| Profiling of isolated miRNA | | | | | | |
| Bioinformatics analysis | | | | | | |
| Detect DNA and protein signatures | | | | | | |
| **3. Model Analysis** | | | | | | |
| Cross-correlation of signatures | | | | | | |

Deliverables.

| Effort/Task | *Deliverable* | Notes |
|---|---|---|
| **1. Model Advancement** | | |
| Scano-miR validation | | Using synthetic miRNA molecues, we will validate the scano-miR platform. This will lay the foundation for further detection and identification of relevant miRNA biomarkers for anthrax profiling. |
| Development of threat model | Threat hypothesis model | Plan to discover biomarkers including DNA, protein, miRNA, and chemical targets for anthrax. |
| **2. Biomarker Research/Discovery** | | |
| Sample processing and isolation | | |
| Profiling of isolated miRNAs | | |
| Bioinformatics analysis | Bioinformatics analysis.<br>List of Biomarkers. | |
| Detect DNA and protein signatures | Biomarker (DNA, miRNA, protein) binding and detection with SNA-AuNPs *in vitro*, and miRNA biomarkers for bacterial infection (in mice).<br><br>Detection of anthrax-associated signatures with SERS nanosheets | |
| **3. Model Analysis** | | |
| Cross-correlation of signatures | Final Report | |

Detailed description of the objectives, scientific relevance, technical approach and expected significance of the work. The first milestone is the development of our threat hypothesis model and biomarker identification plan (Figure 1). Ultimately, the goal is to use nanomaterials to detect a variety of biomarkers (specific miRNAs, DNAs, proteins from blood and chemical signatures) with high specificity and scalability. While this milestone is ongoing, the first deliverable would be a detailed threat model similar to what we have laid out in this proposal, but with more information about the biomarkers, bioassays, and how they will be carried out. Specifically, a test plan for the biomarker studies, including specific nucleic acid targets for

anthrax detection, chromosomal gene targets/assays for anthrax, and specific target/assays for antigens associated with anthrax toxins, would be ready within four months.

The second milestone is geared towards the identification and detection of bacterial and anthrax-associated biomarkers using our nanomaterial constructs. The initial verification of our miRNA scanner system and biometric methods through the use of PCa served to validate the scano-miR as a platform for miRNA discovery. This strategy will confirm the potential for miRNA profiling of anthrax because we can verify our miRNA bioinformatic analysis against suspected PCa miRNAs in authentic samples. In fact, there is no information about the miRNA transcriptomics of anthrax, so this work is unique in that it utilizes miRNA deep profiling for determining terrorist activity. We plan to extend the capabilities of the scano-miR method to biological samples from mice inoculated with infectious bacteria.

The operation of the scano-miR platform is elegantly simple and straightforward (Figure 3).[7] In a typical experiment, miRNAs isolated from clinical samples are hybridized to a microarray surface that has been pre-coated with miRNA probes against 1146 known miRNA sequences, then SNA-AuNPs, nanostructures comprised of highly oriented and densely functionalized oligonucleotides attached to the surface of gold nanoparticles, are deposited. These oligonucleotides contain sequences that are complementary to a universal DNA sequence attached to the miRNA targets. Upon hybridization of the SNA-AuNPs to the target miRNAs captured on the microarray chip, Au ions can be catalytically nucleated on the surface of these AuNPs. Gold enhancement significantly improves the Rayleigh scattering intensities of the AuNP core, allowing for the ultrasensitive detection of miRNAs using a flatbed scanner.

In principle, the scano-miR platform can be used to identify miRNA targets for a wide variety of disease diagnostic applications. In preliminary work, it has been applied successfully to identify 163 new miRNA targets in tissue samples collected from *two* PCa patient cohorts (one with slow-growing cancers and the other with aggressive cancers) and identify the aggressive tumors with 98.8% accuracy.[7] Due to the small sample size, however, we could not validate whether any of these 163 identified miRNA targets were indeed predictive *signatures* of PCa in a more general cancer patient population.

Validation of the scano-miR platform is an important step in developing this technology as a tool for profiling human exposure to chemical and biological threats. We plan to validate this novel nanoscale platform through the use of known synthetic miRNA molecules added to serum samples. Along with our added miRNA of interest, we will harvest and isolate exosomal miRNA from serum samples and use T4 RNA Ligase II to ligate a universal DNA linker to each isolated miRNA molecule. Next, we will incubate the entire ligated miRNA mixture on commercially available miRNA microarrays displaying complements to all known human miRNAs along with the complement to our chosen miRNA as well as an appropriate control miRNA with a single nucleotide mismatch. We will then incubate spherical nucleic acid (SNA) constructs, which have been densely functionalized with the complementary linker oligonucleotide, with the miRNA microarray. After several washing steps to remove unbound SNAs, the gold signal will be amplified through deposition of $Au^0$ and the entire microarray will be imaged with a scanner.

This procedure will determine the sensitivity and specificity of the scano-miR assay. In addition, the assay will enable us to account for background signal and potential cross-talk between neighboring binding sites by adding SNAs with DNA sequences that are non-complementary to the universal DNA linker ligated to each miRNA. In this case, we can account for any non-specific binding of SNAs. We will also be able to analyze the limit of detection and

generate calibration curves for our miRNA of interest. This level of validation is crucial to the development of scano-miR technology, and this study will lay the foundation for further detection and identification of relevant miRNA biomarkers for anthrax profiling.

PCa is one of only a few diseases where miRNAs have emerged as new candidate biomarkers for early detection.[25] miRNAs are regulatory elements believed to control between 30-90% of all protein-coding genes in the human genome by binding to the 3'-untranslated region (3'-UTR) of target mRNAs.[26-29] Importantly, miRNA expression levels have been shown to be tissue- and function-specific.[13] Moreover, miRNAs in the bloodstream are protected from nuclease degradation and can be extracted for detection and downstream analyses.[30,31] If unique miRNA signatures exist for any particular disease (e.g., viral-, bacterial-, or cancer-related) or state of threat exposure, one can envision the development of a sensitive detection platform that can rapidly identify and diagnose individuals based upon the presence of their miRNA signatures by simply screening their blood serum samples. Therefore, molecular screening tools that allow one to identify miRNAs and measure their concentrations at biologically relevant levels in blood samples may revolutionize the study and diagnosis of disease and threat exposure in general.

It is challenging to directly detect cell-free miRNAs in serum because they are short and at relatively low concentrations; therefore, enzymatic amplification is needed. Serum miRNAs are also only present in diluted forms and low-abundance miRNAs are lost.[32] With the scano-miR system, we can profile low- and high-abundance disease-linked miRNAs.[7] In particular, we have shown that multiple types of miRNA targets can be simultaneously detected from tissue samples isolated from selected PCa patients.[7]

There are many commercially available miRNA isolation kits that are optimized to include only small RNAs (of ~20 nucleotides) during isolation. We currently use the mirVana Paris miRNA isolation kit (Ambion). Approximately 2 μg of RNA is needed per miRNA array. Once isolated, target miRNAs will be ligated to 20 nucleotide universal linker sequences using T4 RNA ligase enzyme. We will then add the modified miRNA mixture to the Invitrogene NCode V3 miRNA microarray chip, which has expression coverage of 1146 miRNAs based on the most recent miRNAs cataloged in the Sanger Sequence Database. These microarrays allow hybridization of one sample per chip; therefore, 30 chips will be used. To account for variability in RNA isolation and extraction, we will include 12 replicates (4 from each category for the PCa study). Microarray analysis will result in a large data set to analyze and interpret (over 48,132 data points). The data will be analyzed with the help from the Northwestern University Bioinformatics Core Facility.

Once we have verified our method and analysis, we will analyze the miRNA profiles with mice that have been infected with bacteria (i.e., *Acinetobacter baumannii*)) to compare miRNA levels from infected and uninfected mice. The objective is to determine if microRNA profiles in the blood of mice are sensitive and specific for the identification of bacterial infections. We will prepare the mouse model and samples (i.e., blood). Then, we will follow the protocol that we initially developed for determining PCa miRNA profiles. We will use bioinformatics analysis to determine, or cluster, any miRNA profiles that change with infection. This work represents the first step toward developing miRNA biomarkers for anthrax, by utilizing tightly controlled mouse models that can be extended to more complex bacterial infections. For example, this work could be easily extended to other bacterial infections (e.g., *Pseudomonas aeruginosa, Klebsiella pneumoniae*) to see how specific the assay is for detecting *Acinetobacter baumannii.* Alternatively, we could also vary the severity of infection (i.e., reduce the bacterial inoculum) and vary the time at which detection is attempted (i.e., 1 hr, 12 hr, 24 hr, or 4 days after

infection) to see how sensitive the assay is. The deliverables associated with this task include: 1) a protocol detailing the mouse model, inoculation, and study details at month four in the test plan for biomarker discovery; 2) and samples (blood) from the mouse model for miRNA analysis and a report detailing our analysis and findings, which will include miRNA biomarkers for bacterial infection.

The next subtask is the design of SNAs that can detect bacterial DNA signatures of *B. anthracis*[16,33] and the protein protective antigen (PA) which is the main component of a three-part protein toxin secreted by the bacterium.[17,18] Specifically, we will synthesize oligonucleotide capture strands capable of binding the gene targets capB and capA, which are present in virulent forms of *B. anthracis*. We will also synthesize oligonucleotide antigens that are known to bind with PA, which is a key protein of the anthrax toxin. Conceptually, the biomarkers present in serum would bind with the miRNA targets on the same chip and have a similar readout mechanism. However, because these capture sequences are longer compared to our miRNA targets, additional research is necessary in order to engineer the SNAs to work within the parameters of the assay and bind DNA strands 30-40 nucleotides in length. The goal of this task is to synthesize the capture strand oligonucleotides, determine the parameters for dense loading, synthesize or buy the biomarkers (capB, capA, and PA are all commercially available), and confirm binding to our SNA constructs.

We will also undertake studies related to the synthesis and development of SERS nanosheets (Figure 4). In this task, we plan to optimize the SERS signal from the sheets by engineering the metal nanoparticles that are embedded within the silica sheet. The second subtask is the engineering of the nanosheets to wrap and conform around micron-sized structures like cells, bacteria, dust, and dirt. By adsorbing to the surface of structures typically found on human skin, the sheets effectively position large E-fields generated from the embedded nanoparticles in proximity to interfaces where chemicals associated with day-to-day bioterrorist activities are likely to reside. Thus, this platform is perfect for detecting chemical signatures from any activity that leaves such residues on the human body. According to our threat hypothesis, a person handling weaponized anthrax is likely to have spores (note a person needs to inhale about 10,000 anthrax spores to be in danger)[24] or dust/dirt contaminated with chemicals used in the production of anthrax on their skin. The goal of this task is to maximize the signals from the sheets SERS signal >1000 CPS per nanosheet for 1,4-BDT, which allows a single sheet to 'light up'

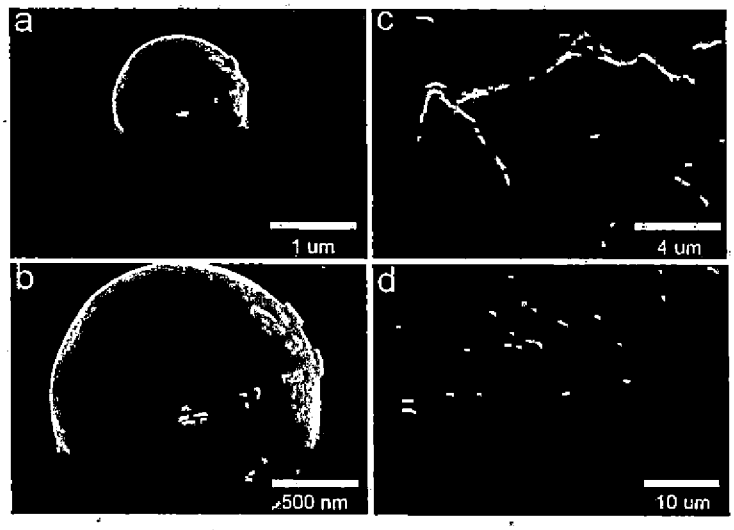


***Figure 6:*** SEM images of the nanosheets deposited on a number of complex topographies. (A,B) Images of the wrapping around and adhering to a micron-sized silica sphere. (C) A group of nanosheets conforming to complex debris/dirt on a silicon wafer. (D) Nanosheets covering a group of *Escherichia coli* cells, where the boundary of covered and uncovered cells is visible.

the chemical signature of a single spore or contaminated particle.

The first subtask will focus on developing a way to control the density (number of dimer particles per $\mu m^2$) of the Au nanorod dimers, concave nanocubes, or nanoprisms that are embedded in the silica nanosheets and determining how this affects their SERS properties (structure-function relationships). Our approach aims to control the density of nanoparticles in the nanosheets by varying the concentration of nanoparticles that are filtered onto the substrate in the first step of the process, creating dispersed nanoparticles across the substrate with a density that can be maintained throughout the remaining synthetic steps. For this, serial dilutions of the nanostructures will be prepared and vacuum filtered onto different substrates before the subsequent silica deposition, lift-off, and Ni etching steps to create the nanosheets. The result will be five different samples of nanosheets with NP densities between 5-50 NP per $\mu m^2$.

To evaluate the SERS response, a monolayer of 1,4-BDT, a small, non-resonant molecule that binds covalently to the Au, will be formed on the Au nanorod dimers.[23] The nanosheets can then be deposited onto a test substrate, in this case a Si wafer, for measurement with a Raman microprobe system (probe sizes of ~ 500 nm and ~ 2 μm), and a portable Raman system (probe size of ~500 μm). These different measurement resolutions will allow us to understand the link between the micro- and macroscale SERS properties of the sheets, which is critical for their design and integration into a chip. We can then determine: 1) the relative intensity (i.e., signal strength) of the SERS signal averaged over a single nanosheet and 2) the relative reproducibility of the SERS signal intensity from each sample across a single nanosheet, multiple nanosheets, and over large (millimeter) areas that encompass hundreds of nanosheets.

The primary objective of the second task is to control and optimize the macroscale properties of the sheets by developing methods for controlling the overall size of the nanosheets and how they envelop microstructures (Figure 6). Sheets with an optimum nanoparticle density (as determined from task 1) will be deliberately synthesized with varying nanosheet thickness. The thickness will be controlled by monitoring the deposition in the electron beam evaporator (we will use thickness between 5-25 nm). By controlling thickness, we can engineer nanosheets with improved physical strength, robustness, and flexibility, which will lead to increased edge lengths (i.e., bigger sheets). We will determine the optimum thickness that produces large sheets, while maintaining the flexibility and strength required for deposition on dust, dirt, cells, and other microstructures. Using electron microscopy, we will determine: 1) the thickness of the nanosheets, 2) their size or edge length, and 3) their flexibility. The flexibility of the structures can be qualitatively evaluated by depositing nanosheets with different thicknesses on a substrate of known surface curvature and determining: 1) how well the sheets conform to the substrate and 2) if the nanosheets tear or break. The associated deliverables include a detailed protocol of the experimental procedure and assay. In total, we expect our identified biomarkers to span many biomarker paradigms, from long term changes in miRNA levels, short term exposure to the bacteria (even before it has produced spores), to the chemicals indicators of anthrax production, and finally to the spores themselves.

We will ultimately use SERS nanosheets for the detection of signatures associated with the production of weaponized anthrax like spores, sporicides, and polymyxin-lysozyme-EDTA-thallous acetate (PLET), which is a chemical commonly used to isolate *B. anthracis* in contaminated samples.[34] We will accomplish this by testing our nanosheets with micron-sized silica beads that we will dope with unique chemical signatures and then add to simulated sweat (water, minerals, urea). We will vary the concentration of the beads in simulated sweat solutions from 100 to 10,000 particles/mL and deposit 10 μL of this solution onto a substrate with the

SERS nanosheets. After drying we will use our Raman system to measure the SERS from the entire sample area (~500 μm in diameter).

The third, and last, milestone will culminate in the final report that will include the complete mature threat hypothesis model. In the final report, we will summarize our findings and discuss our strategy to develop a biomarker profile for anthrax using our nanoconstructs. All metadata associated with the biomarker discovery and identification will be included. The exit criterion for this effort will be the submission of the final report.

State-of-the-art. The current workhorse technologies for miRNA detection are high-density microarrays, quantitative real time PCR (qRT-PCR), and deep sequencing methods; however, no single technique provides the ability to study miRNAs at low cost, with high selectivity, at low abundance, in a high throughput and multiplexed fashion. In all cases, the detection of low abundance miRNAs (below 10 fM) is a major obstacle because of their short length (typically 20-25 nucleotides). Due to its superb sensitivity, polymerase chain reaction (PCR) is widely regarded as the gold standard for detection of nucleic acids. Its exponential increase in target population gives rise to faster detection kinetics and pushes the thermodynamic equilibrium of the capture-analyte reaction toward the bound state of the analyte.[35] Yet, the enzymatic processes associated with target amplification in PCR are often unstable and variable, limiting their utility in the scaled-up, industrial setting. Lengthy optimization procedures are also necessary for the multiplexing of biomarkers using PCR. In relation to this proposal, profiling assays based on qRT-PCR can profile a small population of miRNAs with high sensitivity,[30,32] but are not suitable for high-throughput profiling applications. The short length of miRNAs and their low concentrations in serum and tissue samples also make them extremely difficult to directly amplify by PCR.[36] While one may overcome the length limitation of miRNAs by ligating their 3' and/or 5' ends, the design of appropriate primers is still challenging. Other conventional technologies for the specific profiling of miRNAs include high-density miRNA arrays and deep sequencing methods. miRNA arrays typically employ molecular fluorophores as target labels for direct detection without PCR amplification,[37,38] but are prone to false negatives due to their poor detection limits (>1 pM).[39] Deep sequencing of miRNA libraries from biological samples can detect microRNA in a highly specific and quantitative fashion, yet this method has a lower sensitivity than qRT-PCR due to its requirement for PCR amplification where the relative abundance of miRNA in the starting materials cannot be preserved.

Recently, we developed a proof-of-concept scanometric miRNA profiling assay (scano-miR) based upon the use of SNA-AuNPs.[7] The scano-miR platform is ideal for detecting short, relatively low abundance miRNAs without the need for enzymatic amplification steps. Preliminary data demonstrate its ability to identify miRNA markers with higher sensitivity and selectivity than traditional fluorophore-based high-density chip techniques. The scano-miR platform thus far can detect fM concentrations of miRNA from serum (note current LoD of DNA with similar technique is ~100 aM), and it exhibits relatively high selectivity with the capability of identifying single nucleotide polymorphisms.

We have also recently invented SERS nanosheets, a new class of SERS nanomaterials.[3] These structures consist of thin films of silica embedded with enhancing Au nanorod dimers, and they form the basis for a new detection system that can detect chemical signatures from complex surfaces. We have demonstrated the applicability of these materials for the detection of drugs and drug analogs on the complex surfaces of US currency (dollar bills).[3] While many other groups are focusing on the synthesis and fabrication of strongly enhancing nanostructures for SERS, the

vast majority of these techniques are surface-based and result in structures that cannot be transferred to other surfaces or materials. Of those that result in solution-dispersible enhancers that can be deposited onto other materials, there are two critical challenges in implementing them: 1) synthesizing dispersible nanoparticles in high yield and high monodispersity with control over their optical properties and 2) forming discrete dimers that will not aggregate when deposited onto surfaces. Nanosheets address both of these challenges by: 1) using nanorod dimers created by on-wire lithography (OWL), which provides fine control (single nanometer precision) over the diameter, gap size, and rod lengths over the structures that are synthesized in high yields (~96%), and 2) uniformly embedding the dimers into thin silica nanosheets that fix the density and positions of the structures to prevent aggregation and control their deposition. In this proposal, we will study how SERS nanosheets interact with discrete micron-sized objects like dirt, dust, pollen and bacteria.

Data sources.

The project goals within this proposal will be achieved through data sources that comply with all U.S. Laws, User Agreements, Terms of Service and Copyright Laws. The main data sources include: a WiTec Raman microprobe system and a portable Raman Enwave Optronics, Inc. EZ-Raman-I-785 portable Raman spectrometer. Both instruments will provide quantitative Raman signals that can be used to probe the SERS of the nanosheets at both macroscopic and microscopic levels. In addition, a Hitachi S4800-II scanning electron microscopy and a Hitachi HD-2300A scanning transmission electron microscopy, both housed at the Northwestern University Atomic and Nanoscale Characterization Experimental Center (NU*ANCE*), will provide nanometer level measurements of the nanosheets (i.e., their size, thickness) and also the architectural parameters of the Au nanorod dimers (i.e., their size, diameter, gap spacing, etc.). Other sources of data include a Cary 5000 UV-Vis with both substrate and liquid sample holders for characterization of the optical properties of the nanosheets. In addition, a wide range of equipment, shared facilities, and in-lab resources are available to meet any foreseeable characterization or fabrication challenge associated with the objectives and milestones of this proposal.

Deliverables.

| Effort/Task | *Deliverable* | Notes |
|---|---|---|
| **1. Model Advancement** | | |
| Scano-miR validation | | |
| Development of threat model | Threat hypothesis model | Plan to discover biomarkers including DNA, protein, miRNA, and chemical targets for anthrax. |
| **2. Biomarker Research/Discovery** | | |
| Sample processing and isolation | | |
| Profiling of isolated miRNAs | | |
| Bioinformatics analysis | Bioinformatics analysis. List of Biomarkers. | |
| Detect DNA and protein signatures | Biomarker (DNA, miRNA, protein) binding and detection with SNA-AuNPs *in vitro*, and miRNA biomarkers for bacterial infection (in | |

| | | |
|---|---|---|
| | mice).<br><br>Detection of anthrax-associated signatures with SERS nanosheets | |
| **3. Model Analysis** | | |
| Cross-correlation of signatures | Final Report | |

Cost, schedule, and milestones.

| Milestone/Task | Deliverable | Month Completed | Cost |
|---|---|---|---|
| **1. Model Advancement** | | | **$271k** |
| Scano-miR validation | | 4 | $146k |
| Development of threat model | Threat hypothesis model | 4 | $125k |
| **2. Biomarker/Bioassay Development** | | | **$1,463,000** |
| Sample processing and isolation | | 24 | $351k |
| Profiling of isolated miRNA | | 20 | $407k |
| Bioinformatics analysis | Bioinformatics analysis<br>List of biomarkers: miRNA, DNA, proteins | 24 | $210k |
| Detect DNA and protein signatures | Biomarker (DNA, miRNA, protein) binding and detection with SNA-AuNPs *in vitro*, and miRNA biomarkers for bacterial infection (in mice).<br><br>Detection of anthrax-associated signatures with SERS nanosheets | 20 | $495k |
| **3. Model Analysis** | | | **$190k** |
| Cross-correlation of signatures | Final Report | 24 | $190k |

Offeror's previous accomplishments. The Mirkin group performs research in the forefront of bionanotechnology, and has noteworthy expertise in the synthesis of novel nanoscale architectures and devices and development of functional bio-inspired materials. In 1996, the Mirkin group first reported an approach to prepare SNA nanostructures comprised of densely packed, highly oriented oligonucleotides covalently attached to the surface of gold nanoparticles.[1,2] These nanostructures exhibit properties distinct from their constituent nanoparticles and nucleic acids and from 1D (linear), and 2D (circular) forms of nucleic acids.[40] Since its creation, the SNA platform has been commercialized and heavily utilized in applications including *in vitro* medical diagnostics,[7,8,10] intracellular gene detection and regulation,[11] and lately, nanoparticle assembly to construct highly ordered colloidal superlattices *via* programmable DNA interactions.[40]

In the context of medical diagnostics, SNAs exhibit many attractive properties which include: (i) hybridization-dependent optical changes, (ii) a reversible thermal transition over a narrow temperature range, and (iii) a high binding constant (~100 times more) compared to free DNA of the same sequence.[41] In particular, upon the addition of target DNA strands, gold nanoparticles that are surface-modified by oligonucleotides of judiciously chosen sequences based on complementary base pairing can be programmed to form ordered, macroscopic aggregates. The aggregation process can be visually or spectroscopically monitored by a distinct

change in the color of the solution of AuNPs from red-to-blue due to the interaction of particle LSPRs.[42] Notably, the aggregate derived from a perfectly complementary target nucleic acid sequence exhibits sharper thermal transitions than duplexes formed from molecular fluorophore probes of the same sequence,[39] and can be differentiated from target DNA strands with a single-base mismatch, insertion, or deletion. Because many diseases involve single nucleotide polymorphisms,[43] this observation is clinically relevant and represents a significant advance in molecular diagnostics. The high extinction coefficient of AuNPs allows for the detection of targets at lower concentrations than molecular dyes. These optical and melting properties of SNAs laid the foundation for their use as a colorimetric-based diagnostic platform to detect a wide array of analytes. To date, proven targets detectable by the colorimetric-based assay include nucleic acids,[39,44] known DNA binding molecules (e.g., ethidium bromide, 4',6-diamidino-2-phenylindole (DAPI)),[45] amino acid,[46] and specific ions (e.g., $Cu^{2+}$, $NO^{3-}$).[47,48] Additionally, utilizing the Au OWL dimer motif, the Mirkin group has demonstrated the ability to detect a number of small molecules,[3,19,20] as well as DNA[37] using non-colorimetric methods, which can provide information about the chemical structures of the target molecules.

To improve the sensitivity afforded by colorimetric-based systems, the Mirkin group developed another SNA-based detection method called the "scanometric assay".[39] In this assay, SNAs that contain oligonucleotides complementary to one portion of the sequence of the target DNAs are immobilized, in a sandwich assay, to a glass substrate coated with oligonucleotides that contain another portion of the same DNA sequence. The catalytic reduction of silver or gold ions onto the immobilized SNAs provides the scanometric assay with excellent sensitivity by enhancing the scattering properties of the gold nanoparticle core of SNAs. This "scanometric" assay enables the detection of attomolar ($10^{-18}$) concentrations of nucleic acids and proteins in complex biological samples.[8] Since its discovery in 2000, the scanometric assay has been commercialized, and integrated into a system that has received FDA clearance for use in many molecular diagnostic applications. To date, proven biomarkers detectable by the scanometric assay include DNA,[39] proteins,[8,48] metal ions,[49] and very recently, miRNA.[7]

In terms of nanomaterials synthesis, the Mirkin group has extensive experience. We invented the OWL technological platform in 2005 and have since been developing these structures in a suite of novel applications including molecular electronics,[50,51] detection,[52,53] catalytic nanomechanical systems,[54] nanoscale encoding,[51] fundamental plasmonic investigations,[55,56] and SERS.[3,52,57] Further, we have developed the nanosheet platform, which we used to detect cocaine on U.S. dollar bills,[3] and are experts over the parameters associated with this system. Synthetically, we are well equipped and able to achieve each of the claims, goals, and objectives detailed in this proposal, and, in the past, we have demonstrated the ability to develop a number of other nanoparticle-based chemical and biological sensors that are capable of trace detection.

Facilities.

**Mirkin:** Mirkin group lab space in the Northwestern Institute for Nanotechnology consists of 8,852 sq. ft. of state-of-the-art laboratory space and includes wet-chemistry labs, chemical storage (bulk flammables, stock compounds, etc.), as well as custom-designed low-vibration microscopy labs Mirkin office space includes the P.I. office (1,100+ sq. ft), offices for postdoctoral fellows and students in the research group (2,164 sq. ft.), and dedicated conference and meeting room (847 sq. ft) with A/V equipment.

We have a local area network composed of 60+ PCs and Macintosh computers. Network

access is available in all offices and labs. All past and present research data is collected and archived on a 5.2 TB capacity Mac Pro running OS X Server and connected to the network with a 1Gbps switch. This enables the entire catalogue of research data to be remotely accessible by group members from anywhere in the world. Additional HP and Macintosh workstations are available for molecular modeling, analytical data analysis, and general use. A 16-core PQS (16-core Parallel Quantum Solutions) cluster is used for simulations running ADF (Amsterdam Density Functional 2009). Two 12-core Mac Pros each having 64 GB of RAM and running Lumerical FDTD Solutions are used to simulate the plasmonic properties of metal nanostuctures. Additional software packages include Wavefunction Spartan, Schrödinger MacroModel, Jaguar, Cambridge Crystallographic Data Center Suite including Mercury and Conquest, MestReNova, Topspin, Crystal Maker, Materials Studio, and Cinema 4D. We also have free online-access to many scientific databases such as SciFinder Scholar, Beilstein Crossfire, Medline, and Science Citation Index16.

Equipment available and maintained in the Mirkin group's own laboratories includes the following: The necessary laboratory and bench space, chemical, and general laboratory supplies to carry out the day-to-day research required for the development, characterization, and implementation of chemical compounds, nanomaterials, and biomaterials, standard equipment and instrumentation: fume hoods and compressed air lines, glove boxes, nitrogen boxes, Schlenk lines, vacuum pumps, extensive inventories of chemical and biological reagents for nanoparticle and biological synthesis and assay analysis, solvent systems, deionized and/or Nanopure™ water purification systems, furnaces and ovens, refrigerators and freezers, hotplates with magnetic stirring capability, rotary evaporators, desiccators, lyophilizers, optical characterization equipment (e.g., UV-vis, FTIR, Raman, and fluorescence spectrometers), spectraradiometers, flash chromatography set-ups, separations instrumentation (e.g., HPLC, GC), thermal analysis equipment (e.g., TGA), autoclaves, top loading and digital analytical balances, Parr Hydrogenators, centrifuges, shakers, peptide, DNA, and RNA synthesizers, zeta and dynamic light scattering, and scanning probe microscopes.

Specifically, the Mirkin lab owns two Park Scientific XE150 AFMs with non-contact, intermittent contact, and lateral force detectors, all encased in humidity-controlled glove boxes for environmental control, a NanoInk Nscriptor, a NanoInk NLP 2000, and a NanoInk DPN 5000 AFM instruments, a Bruker Dimension Icon AFM and DI Multimode AFM with contact, intermittent contact, solution, and electrical bias capabilities, an inverted Zeiss Axiovert 200M fluorescence microscope with CCD and light scattering attachments, a WiTec alpha300Rconfocal Raman scanning near-field optical microscope with SNOM capabilities, a PerkinElmer Piezoarray non-contact inkjet printer, a GMS 417 Microarrayer, a BOC Edwards Auto 306 thermal evaporator and Lesker PVD75 E-beam evaporator for metallic thin film deposition, an Applied Biosystems DNA synthesizer, an Oxford Instruments liquid He cryostat with optical access for low temperature charge transport and optical spectroscopy, various Keithley instruments electronics modules for low-current measurements, four nitrogen glove-boxes for inert-atmosphere chemistry, a Brookhaven 90Plus Particle Size Analyzer, a Bruker 400 MHz NMR spectrometer with a 1H-19F/15N-31P AutoX DB NB Probe for measurement of a large range of nuclei (1H, 31P, 13C, 19F, 15N, 195Pt, 11B, etc.), automatic tuning and switching capabilities, and a temperature controller, a BASI Epsilon e2P231000 electrochemical setup, Amsterdam Density Functional 2009.01 (ADF) software package running on a dedicated PQS Parallel Quantum Solutions 16-core computational cluster, Materials Studio (Accelrys) running on a dedicated Dell OptiPlex 9010 (3rd Gen Intel Core i7-3770S Processor (Quad Core,

3.10GHz, 8MB) with 16GB RAM), an Analtech Cyclograph, a Horiba Jobin Yvon Fluorolog 3 fluorimeter (variable temperature, solution, solids, and glasses), two Cary 5000 UV-Vis with Variable Temperature Controller with both substrate and liquid sample holders, a Ti-Sapphire laser pumped by Ar+multi-line laser for Raman spectroscopy (w/ CCD spectrometer), a Bioautomation Corp. Mermade 6 RNA Synthesizer, a dedicated cell culture space, four Varian ProStar HPLCs, a Photal FluorDia T70, a BioTeck Synergy H4 Hybrid Reader, a Malvern ZetaSizer with an autosampler, a Nanosphere Verigene ID, a Genemachines OmniGrid Accent, a LS Reloaded Tecan Microarray Scanner, an Enwave Optronic EZRaman, a Picoquant Photonics FluoTime 300, a Spectrum Tangential Flow Filtration System, a Zeiss Axioobserver Z1m microscope coupled to a PI Acton PyLoN:400BR/LN Digital CCD Spectroscopy System for microspectroscopy, and a BD biosciences FACS Aria flow cytometer/cell sorter, a Guava 17 Easycyte and an Easycyte plus flow cytometers, a TA instruments Discovery TGA, a nanodrop 200 UV/vis spectrometer, a Zeiss Axioobserver A1 epifluorescent microscope.

**Davuluri:** The Davuluri laboratory consists of both wet-lab and office cubicles for informatics research staff. The laboratory space is located on the 2nd floor of the Tarry Research Building. The office space for postdocs and research staff is located in the NUBIC area of the Rubloff Building. The center consists of a dedicated computer server room, office space for staff scientists, bioinformatics programmers, postdoctoral fellows and graduate students and a conference room. The lab is fully equipped with refrigerators, freezers, centrifuges, pectrophotometer, speed-vac, electrophoresis equipment, water purification system and a dedicated PCR area. One lab bench dedicated to radioactive studies including array hybridization ovens, centrifuges, heating blocks and water baths. A separate tissue culture area and a common use cold room are adjacent to the lab as well. Prof. Davuluri's group is fully furnished with computer workstations connected to a Gigabit Ethernet switch protected by a firewall on the university network (NUNet), providing access to various networked resources (high speed printers, color printers, secure backup storage, shared databases, department network storage, e-mail), and to other University resources and Internet2 at 1 gbps on campus. The University provides collaborative research data storage and web-based document management tools, Depot and Vault. These provide a secure, central repository where users can upload, store, and share documents or files that may contain sensitive information, or are too large to send through traditional e-mail. The Davuluri lab has dedicated access to 160 cores of Quest (the university's high performance computing system) and dedicated storage of 30TB on Vault (University's central storage platform for research information). Quest is ranked on the TOP500 list of the fastest computers worldwide. In addition to the extensive list of software modules developed or used by Davuluri group (see https://github.com/NUBIC/) Bioconductor, R, Ruby, and Ruby on Rails are common packages installed and used by the group members. The Core uses open source extensively for application development.

**Thaxton:** The Thaxton laboratory is located in the Northwestern Lurie Research building in Chicago, IL at the Feinberg School of Medicine campus. This building is approximately 8 years old, and the laboratory space is state-of-the art. The Thaxton lab has approximately 1,500 square feet of biology lab space, and 200 square feet of wet-chemistry space. This includes ample bench space (approximately 20 sq ft/researcher), chemical fume hoods x 3 and adjacent bench space (200 sq ft), BSL-2 biological research hood (x2), cell culture facility (140 sq ft), and the chemical characterization equipment needed for basic nanoparticle characterization. The PI's

office is approximately 150 square feet with meeting space for students. There is adequate desk space for 10 researchers, approximately 40 square feet/student. A conference room and A/V equipment is available.

**Animals:** We have access to 300 sq ft barrier room for immune compromised mice, conventional animal care room and animal procedure rooms in Robert H Lurie Animal Care Facility. The Center for Comparative Medicine (CCM) is responsible for the purchase and care of all experimental animals at Northwestern. The CCM is under the supervision of four full-time board-certified veterinarians and is approved by the AAALAC. All the procedures have been approved by Institutional Animal Care and Use Committee. In the CCM, a barrier room with forced air and water lines is available for the keep on immunodeficient mice, which are essential for the proposed tumor studies. Barrier room for transgenic animals is also available.

**Major Equipment:** Agilent HP8453 UV/Vis with Peltier Temperature Controller, Malvern Zetasizer Nano ZS, Bio-Tek fluorescent / UV-Vis plate reader, Varian reverse phase HPLC, Millipore real-time PCR machine. Spex Fluorolog 3 fluorimeter (variable temperature, solution, solids, and glasses), Beckman Coulter liquid scintillation counter, Bio-Rad PCR, Kodak Gel Imaging Station, Beckman Ultra-Centrifuge, Liquid and Vapor phase liquid nitrogen cell container, -80 Freezers, 4 C refrigerators, Millipore Nanopure™ water system.

**Computers:** A PC-based LAN and 3+ PCs are available in all offices and labs. A Xerox printer is available on-line. Through Northwestern University, the Thaxton Lab has a Depot site for data backup and storage which is available to all group members and is password protected. Through the Northwestern University Library System, all researchers have access to the paper and on-line resources which include a number of national databases, on-line books, and periodical materials.

**Hauser:** The Hauser Laboratory is located on the 4$^{th}$ floor of the Morton Biomedical Research Building, in the midst of the Feinberg School of Medicine at Northwestern. It consists of approximately 1,000 square feet of research space. The space houses capital equipment, work benches, and a tissue culture room. The main laboratory contains all the equipment necessary to perform routine molecular biology, microbiology, and biochemistry techniques. Prof. Hauser's office is 130 square feet in size and located immediately adjacent to his laboratory space, permitting frequent interactions between Prof. Hauser and the members of his laboratory. The laboratory benches in the Hauser Laboratory have attached desks designated for laboratory members.

**Computer:** The laboratory space includes two Macintosh desktop computers, a Dell computer, and a color printer dedicated for general laboratory use. In addition, an Apple Mac Pro 2 x 2.4 GHz Quad-Core Intel Xeon processors with 64 GB RAM, 4 x 1 TB internal hard drives and 2 x 3 TB external back-up storage hard drives is designated for genomic sequencing projects. A MacBook Pro computer and laser-printer are in the PI's office. Word processing, graphics, sequence analysis, and database software are available. A computer support technician is located within the same building complex as the PI's laboratory. All computers are linked to the internet and to a shared server that allows for sharing of data and for scheduled backups to tape.

**Animal:** The Center for Comparative Medicine (CCM) is a certified animal care facility at Northwestern University and is located across the street from the PI's laboratory. It includes pathogen-free barrier as well as ABSL-2 containment facilities. The CCM is an AAALAC accredited facility and a member of AALAS. All work is approved in advance by the Northwestern University Animal Care and Use Committee, in accordance with "Principles for

the Utilization and Care of Vertebrate Animals Used in Testing, Research and Training." Resident veterinarians and staff provide veterinary medical services for all mice housed in the facility and are responsible for daily inspections to observe and treat animals, monitor disease control and prevention and provide technical assistance if required. Space and equipment for performing bacterial inoculation experiments and post-mortem examinations.

**Biohazards:** The proposed set of experiments requires utilization of *Acinetobacter baumannii*. This bacterium is not considered a "special agent" but will be handled under BSL2 conditions. The Hauser Laboratory is designated as a Biohazard Safety Level 2 facility, so all equipment and resources are in place to work with the biohazardous agents described in this proposal. All members of the Hauser Laboratory undergo appropriate training in BSL2 practices. In addition, Prof. Hauser has served on the Institutional Biosafety Committee at Northwestern University, so he is familiar with the relevant regulations and guidelines and is involved in the training of each laboratory member. When working with *A. baumannii*, personal protective laboratory equipment will be worn at all times, including lab coats and latex gloves. All specimens contaminated with this bacterium will be disposed of as biohazardous waste, and all bacterial cultures will be sterilized before disposal. The work space will be cleaned after use with 70% ethanol.

**Equipment:** The laboratory includes a low-speed centrifuge, tabletop centrifuge, three microfuges, a refrigerated microfuge, 2 floor high-speed centrifuges, 2 refrigerators, 2 -20C freezers, 2 -70C freezers, 2 CO2 incubators, a tissue culture microscope, 37C plate incubator, 2 PCR thermocyclers, a qRT-PCR thermocycler, a fluorescence plate reader, and 2 shaking variable temperature waterbaths. An Apple Mac Pro 2 x 2.4 GHz Quad-Core Intel Xeon processors with 64 GB RAM, 4 x 1 TB internal hard drives and 2 x 3 TB external back-up storage hard drives is designated for genomic sequencing projects. The tissue culture room contains a 6' laminar flow hood. A digital imaging system, dark room with film developer, and ultracentrifuge are conveniently available on a shared basis. Shared departmental microscopes include a Leica fluorescence microscope with digital camera, computer, and OpenLab software. A Xenogen bioluminescence camera and HPLC and chromatography instruments are available in nearby laboratories for the PI's use.

Northwestern University maintains 63 shared and core facilities with extensive instrumentation to which researchers have ready access. Selected facilities that could be used to carry out research related to this grant are listed: **Cancer Informatics Facility** (this core is supervised by Prof. Ramana Davuluri), **High Performance Computing, Northwestern University Biomedical Informatics Center (NUBIC), Integrated Molecular Structure Education and Research Center (IMSERC), Northwestern University Atomic and Nanoscale Characterization Experimental Center (NU*ANCE*), Biological Imaging Facility (BIF), Pathology Core Facility (PCF).**

Detailed Management Plan. Prof. Chad A. Mirkin is a primary investigator for this project; he will devote 10% effort to this project. He is the Director of the International Institute for Nanotechnology and the George B. Rathmann Professor of Chemistry, Professor of Chemical and Biological Engineering, Professor of Biomedical Engineering, Professor of Materials Science & Engineering, and Professor of Medicine at Northwestern University. He is a chemist and a world renowned nanoscience expert, who has authored over 560 manuscripts; he is listed as an inventor on over 900 patent applications worldwide (243 issued). Prof. Mirkin has been recognized for his accomplishments with over 90 national and international awards. These include the Linus Pauling Medal, the $500,000 Lemelson-MIT Prize, the Raymond and Beverly

Sackler Prize in the Physical Sciences, the Feynman Prize in Nanotechnology, and the ACS Award for Creative Invention. He is a Member of the President's Council of Advisors on Science & Technology (PCAST, Obama Administration), and one of only 15 scientists, engineers, and medical doctors to be elected to all three US National Academies (the Institute of Medicine, the Natl. Academy of Sciences, and the Natl. Academy of Engineering). He is also a Fellow of the American Academy of Arts and Sciences. He is the Founding Editor of the journal *Small* and the founder of multiple companies, including Nanosphere, Inc., AuraSense, LLC, and AuraSense Therapeutics, LLC. Mirkin holds a B.S. degree from Dickinson College and a Ph.D. degree from Penn State. He was an NSF Postdoc at MIT prior to becoming a Professor at Northwestern in 1991.

Prof. Ramana Davuluri is a key personnel; he will devote 5% effort to this project. He will be starting in February 2014 as Professor of Preventive Medicine and Director of Cancer Informatics in the Division of Health and Biomedical Informatics in the Dept. of Preventive Medicine at the Feinberg School of Medicine, Northwestern University. He has worked in the areas of bioinformatics and computational genomics since 1998. Coming from a background in quantitative sciences, he gained synergistic expertise in statistical modeling, genomics and bioinformatics, while leading several projects over the past 12 years. His research program is interdisciplinary in nature with a complement of experimental investigation. His lab currently focuses on developing data-mining algorithms and informatics solutions for problems in biology and medicine. The overarching goal of the lab is to translate data from high dimensional (-omic) platforms (e.g., NextGen sequencing) to derive experimentally interpretable and testable discovery models towards genomics-based clinical decision support systems for personalized cancer therapy. His group is developing clinically useful diagnostic tools for identification of subsets of cancer patients, who may benefit from therapeutic intervention and guide the understanding of drug activity in patient tumors. Towards these goals, his group applies a combination of state-of-the-art statistically rigorous data-mining methods and NextGen sequencing based experimental procedures in a systems biology setting. He will provide the bioinformatics, statistics and genomics expertize as a co-investigator.

Prof. Shad Thaxton is a key personnel; he will devote 5% effort to this project. His research efforts and expertise focus on fabricating new nanomaterials and translational nanotechnology with regard to nanoparticle-based molecular diagnostics and nanotherapeutics. He graduated from the University of Colorado with a BA in Environmental Biology. He earned his MD and PhD from Northwestern University in 2004 and 2007, respectively. He joined Northwestern as a full-time faculty member in 2008 in the Dept. of Urology at Northwestern.

Prof. Alan Hauser is a significant contributor; he will devote 5% effort to this project. He is a Professor in Microbiology-Immunology and Medicine-Infectious Diseases at Northwestern. He has studied the pathogenesis of bacterial infections for the past 25 years. His focus over the past 18 years has been on nosocomial pathogens such as *Pseudomonas aeruginosa, Acinetobacter baumannii,* and *Klebsiella pneumoniae.* He has made important and fundamental contributions to understanding the molecular aspects of host-pathogen interactions, including the identification and characterization of virulence factors and how these virulence factors are utilized to compromise host defenses. To accomplish these goals, his laboratory has developed expertise in genomic and bioinformatic approaches that has allowed him to interrogate the genomes of bacteria for novel virulence genes. A second area of expertise is the use of animal models. His laboratory has developed a number of *in vivo* assays for examining the functions of bacterial factors during the course of an infection and to characterize the host immune response

to these factors. Finally, he has studied populations of naturally infected human patients to demonstrate the relevance of some of our findings to human disease. In this regard, his background as a practicing infectious disease physician provides him with a broad perspective on bacterial infections in patients. Together, these skills and experiences will enable him to contribute to the successful completion of the experiments proposed by Mirkin.

Mirkin, Thaxton, and Hauser have a robust history of collaboration, and they have published numerous papers and patents together. Thus, there is a strong likelihood that this project will succeed and also result in such research products. Mirkin will act as the team leader for the proposed research. Mirkin will also be the primary scientist developing both novel SNA and nanosheet platforms and assays employing these structures. Mirkin is highly capable of accomplishing this research. He invented the SNA architecture in 1996 and has since developed it as a platform for chemical and biological sensing, nanotherapeutics, and materials synthesis. In 2005, Mirkin also invented on-wire lithography (OWL), which is used to synthesize the rod-like nanostructures that form the basis of the nanosheet architecture. Mirkin has used OWL-fabricated and nanosheet structures in a variety of areas from sensing to energy conversion to molecular electronics.

Thaxton has both clinical and research expertise. Thaxton is an expert in nanomaterial synthesis and characterization. Most relevant to the work proposed, and in collaboration with Mirkin, Thaxton already helped to develop and validate the scanomiR platform for highly sensitive and specific detection of microRNA biomarkers from human specimens (e.g., blood and tissue). Thaxton will isolate microRNA for analysis and play a large role in scanomiR assay validation and optimization. Additionally, he will regularly interface with Mirkin to troubleshoot, interpret data, and to ensure seamless translation. Davuluri and Hauser are experts in bioinformatics and infectious disease, respectively. Davuluri will perform all biostatistics work; Hauser will perform the animal experiments aimed at analyzing the miRNA profiles in mice infected with *Acinetobacter baumannii*.

Mirkin and Thaxton already meet face-to-face to discuss joint projects. Davuluri and Hauser (and the appropriate students, postdocs, and staff) will join these meetings, where a significant block of time will be devoted to discussing progress and planning the next week's goals for this project. In addition, data and other resources will be shared between the groups as needed via email and Dropbox. Mirkin will be responsible for preparing and submitting the necessary technical and cost reports to IARPA throughout the period of performance. Mirkin has support staff in place that will effectively manage the planning, scheduling, and processing of such requests and oversee the financial aspects of the grant. Note that Mirkin also has extensive experience in managing large team-based projects and working with all branches of the DoD.

Resource Share. Not applicable. No other federal, state, or local agencies or other parties are receiving the proposal or funding the proposed effort.

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(57) M. L. Pedano, S. Z. Li, G. C. Schatz, C. A. Mirkin, *Angew. Chem., Int. Ed.* **2010**, *49*, 78.

RFP:
Contract No.

Contractor Name

# CONTRACT COMPLETION STATEMENT

| | | |
|---|---|---|
| CONTRACTING ADMINISTRATING OFFICE NAME AND ADDRESS: (CONTRACT ADMINISTERED): Federal Bureau of Investigation, Mission Support Contracts Unit, 935 Pennsylvania Avenue, NW, Washington, DC 20535 | CONTRACTING OFFICE NAME AND ADDRESS (CONTRACT AWARDED): Northwestern University, 633 Clark Stree., Evanston, IL 60208 | DATE: 9/14/2016 |
| CONTRACT NO: DJF-15-1200-K-0001730 | LAST CALL OR ORDER NO: | AMOUNT OF EXCESS FUNDS: $0.54 |
| LAST MODIFICATION / ORDER NO: | INVOICE/VOUCHER NO:<br><br>FINAL PAYMENT MADE. DATE: _____ | |

## OTHER ITEMS

| NO | ITEM | YES | N/A | COMMENTS | DATE ACTION COMPLETED |
|---|---|---|---|---|---|
| 1 | Document uploaded into UFMS and modification submitted for processing | | | | |

## STATEMENT OF COMPLETION

***All required contract administration actions have been fully and satisfactorily accomplished.*** *As a result of a final review of the contract file, it is determined that, to the best of my knowledge, all terms and conditions of the above contract have been complied with and the file documented accordingly. All requested deliverables under this contract, as modified, have been received and accepted. The terms and conditions applicable to all the General and Special Provisions of the contract have been met. All actions, if applicable, relating to the settlement and to the disposition of the Government property have been documented. The final invoice has been received, processed and paid to the contractor. Consequently, all necessary actions required to close the subject contract are hereby considered complete.*

b6 -1 Per FBI

[redacted]

9/14/16
Date

Contrac[redacted] Officer Representative

[redacted]

9/19/16
Date

[redacted]tracting Officer Name and Signature

Contract File Destruction Date: _____

FBI(18-cv-5391)-84

RFP:
Contract No.

Contractor Name

# CONTRACT CLOSEOUT CHECKLIST

| | | |
|---|---|---|
| CONTRACTING ADMINISTRATING OFFICE NAME AND ADDRESS: (CONTRACT ADMINISTERED): Federal Bureau of Investigation, Mission Support Contracts Unit, 935 Pennsylvania Avenue, NW, Washington DC 20535 | CONTRACTRING OFFICE NAME AND ADDRESS (CONTRACT AWARDED): Northwestern University, Accounting Services for Research and Sponsored Programs, 633 Clark Street, Room G-547, Evanston, IL 60208-1112 | DATE: 09/15/2016 |
| CONTRACT NO: DJF-15-1200-K-0001730 | LAST CALL OR ORDER NO: | AMOUNT OF EXCESS FUNDS: $0.54 |
| LAST MODIFICATION / ORDER NO: | INVOICE/VOUCHER NO: 14 (SP0027517)<br>FINAL PAYMENT MADE. DATE: 07/27/2016 | |

**COR COMPLETION ITEMS**

| NO | ITEM | YES | N/A | COMMENTS | DATE ACTION COMPLETED |
|---|---|---|---|---|---|
| 1 | Contract Completion Statement | X | | | |
| 2 | Contractor Evaluation Forms and CPARS completed | | X | | |

**CONTRACT CLOSEOUT ACTION ITEMS**

| NO | ITEM | YES | N/A | COMMENTS | DATE ACTION COMPLETED |
|---|---|---|---|---|---|
| 1 | Disposition of Classified material | | X | | |
| 2 | Final patent report is cleared | | X | | |
| 3 | Final royalty report is cleared | | X | | |
| 4 | No outstanding value engineering proposal | | X | | |
| 5 | Plant clearance received | | X | | |
| 6 | Property clearance received | | X | | |
| 7 | All interim or disallowed costs settled | | X | | |
| 8 | Price revision is completed | | X | | |
| 9 | Subcontracts are settled by the prime contractor | | X | | |
| 10 | Prior year indirect cost rates are settled. | | X | | |
| 11 | Termination docket is completed | | X | | |
| 12 | Contract audit is completed | X | | | |
| 13 | Contractor's closing statement completed | X | | | |
| 14 | Contractor's final invoices submitted | X | | | |
| 15 | Contract funds review is completed and excess funds deobligated | X | | | |
| 16 | All change orders definitized | X | | | |

**ADDITIONAL INFORMATION**

| NO | ITEM | YES | N/A | COMMENTS | DATE ACTION COMPLETED |
|---|---|---|---|---|---|
| 1 | Bilateral SF-30 signed | X | | | |

**As a result of a final review of the contract file, it is determined that, to the best of my knowledge that all contractual actions required under this contract have been completed.**

Signature

Date

Title:
Printed Name:

FBI(18-cv-5391)-85

**AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT**

| 1. CONTRACT ID CODE | |
|---|---|
| DJF-15-1200-K-0001730 | |

| 2. AMENDMENT/MODIFICATION NO. | 3. EFFECTIVE DATE | 4. REQUISITION/PURCHASE REQ. NO. | 5. PROJECT NO. (If applicable) |
|---|---|---|---|
| 0004 | 11/23/2015 | DJF-15-2300-PR-0016673 | |

| 6. ISSUED BY | CODE | 7. ADMINISTERED BY (If other than Item 6) | CODE |
|---|---|---|---|
| UNIT CHIEF | | | 1200 |

FEDERAL BUREAU OF INVESTIGATION
MISSION SUPPORT CONTRACTS UNIT
935 PENNSYLVANIA AVE, NW
WASHINGTON, DC 20535-0001

MISSION SUPPORT CONTRACTS UNIT
935 PENNSYLVANIA AVENUE, NW
WASHINGTON, DC 20535-0001

8. NAME AND ADDRESS OF CONTRACTOR (No., street, country, state and ZIP Code)

NORTHWESTERN UNIVERSITY
1801 MAPLE AVE.
2ND FLOOR, SUITE 2410
EVANSTON, IL 60201
DUNS: 160079455

CODE: 362167817 FACILITY CODE: 160079455

(X) | 9A. AMENDMENT OF SOLICITATION NO.

9B. DATED (SEE ITEM 11)

X | 10A. MODIFICATION OF CONTRACT/ORDER NO. DJF-15-1200-K-0001730

10B. DATED (SEE ITEM 13) 02/23/2015

**11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS**

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

FBI-2014-2015-SEY2-2300-2310-B8-B9-1415-RA9767-25102-WMD-2014

**13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.**

| CHECK ONE | |
|---|---|
| | A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A. |
| | B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b). |
| | C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF: |
| X | D. OTHER (Specify type of modification and authority) FAR 52.243-2 |

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

This modification extends the period of performance to 4/30/2016 and incorporates the mutually agreed upon attached descoped SOW and costs.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

| 15A. NAME AND TITLE OF SIGNER (Type or print) | | 16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) | |
|---|---|---|---|
| | | [redacted] | b6 -1 Per FBI |
| 15B. CONTRACTOR/OFFEROR | 15C. DATE SIGNED | 16B. UNITED STATES OF AMERICA | 16C. DATE SIGNED |
| (Signature of person authorized to sign) | | By [redacted] (Signature of Contracting Officer) | 12/29/2015 |

NSN 7540-01-152-8070
Previous edition unusable

STANDARD FORM 30 (REV. 10-83)
Prescribed by GSA FAR (48 CFR) 53.243

## Table of Contents

## Section B - Supplies or Services and Prices/Costs

### SCHEDULE OF SUPPLIES/SERVICES

CONTINUATION SHEET

| ITEM NO. | SUPPLIES/SERVICES | QUANTITY | UNIT | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 0001 | CLIN 0001, 0002, 0003<br>**Line Period of Performance:** 02/24/2015 - 04/30/2016<br>Base Period | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$1,036,987.0000<br>Change: $0.0000<br>Current:<br>$1,036,987.0000 | Previous:$1,036,987.00<br>Change: $0.00<br>Current: $1,036,987.00 |
| 0002 | CLIN 0001, 0002, 0003<br>**Line Period of Performance:** 02/24/2016 - 02/23/2017<br>Unexercised Option 1 | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$887,334.0000<br>Change: $0.0000<br>Current:<br>$887,334.0000 | Previous:$887,334.00<br>Change: $0.00<br>Current: $887,334.00 |
| 0003 | ODC's - Shipping<br>**Line Period of Performance:** 02/24/2015 - 04/30/2016<br>Base Period | Previous :<br>1.000000<br>Change: 0.000000<br>Current : 1.000000 | EA | Previous:<br>$200.0000<br>Change: $0.0000<br>Current:<br>$200.0000 | Previous:$200.00<br>Change: $0.00<br>Current: $200.00 |
| | | | | PREVIOUS TOTAL<br>CHANGE<br>CURRENT TOTAL | $1,924,521.00<br>$0.00<br>$1,924,521.00 |

**FUNDING DETAILS:**

| ITEM NO. | FUNDING LINE | OBLIGATED AMOUNT | ACCOUNTING CODES |
|---|---|---|---|
| 0001 | 2 | Previous : $1,036,987.00<br>Change: $0.00<br>Current : $1,036,987.00 | 2014 - SEY2 - 2300 - 2310 - B8 - 1415-RA9767 - - 25102 - - - - - - |
| 0003 | 1 | Previous : $200.00<br>Change: $0.00<br>Current : $200.00 | 2014 - SEY2 - 2300 - 2310 - B8 - 1415-RA9767 - - 25102 - - - - - - |
| | | PREVIOUS: $1,037,187.00<br>CHANGE: $0.00 | |

CURRENT: $1,037,187.00

**Section C - Description/Specifications/Statement of Work**

**No Clauses**

**Section D - Packaging and Marking**

**No Clauses**

**Section E - Inspection and Acceptance**

**No Clauses**

**Section F - Deliveries and Performance**

**No Clauses**

**Section G - Contract Administration Data**

**No Clauses**

**Section H - Special Contract Requirements**

**No Clauses**

**Section I - Contract Clauses**

Clauses By Full Text

1 Terms and Conditions

Reference Attachment 1 - NW BIC Contract for Sections B-J of contract.

**Section J - List of Attachments**

**No Clauses**

| Identifier | Title | Number of Pages |
|---|---|---|
| 1 | NW BIC Contract | 15 |
| 2 | Attachment A - Tech & Managment Proposal | 24 |
| 3 | Attachment B - Cost Proposal | 10 |
| 4 | Attachment C - FBI IRB Form | 8 |
| 5 | Attachment D - BIC Monthly Financial Status Report Form | 1 |
| 6 | Attachment E - BIC Monthly Technical Status Report Form | 1 |
| 7 | Northwestern_descoped SOW | |
| 8 | Northwestern_Desoped Cost | |