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REPORT DOCUMENTATION PAGE

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| 1. AGENCY USE ONLY (Leave blank) | | 2. REPORT DATE | 3. REPORT TYPE AND DATES COVERED Final Report/1 Dec 88-30 Nov 89 | |
| 4. TITLE AND SUBTITLE (DRUIP) Nozzle Beam Deposited Diamondlike Carbon Films | | | 5. FUNDING NUMBERS 61104D/3842/A6 | |
| 6. AUTHOR(S) Calvin W. Lowe | | | DTIC FILE COPY | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Hampton University Physics Department Hampton, VA 23668 | | | | |
| 8. PERFORMING ORGANIZATION REPORT NUMBER AFOSR-TR-90-1135 | | | 10. SPONSORING/MONITORING AGENCY REPORT NUMBER AFOSR-89-0196 | |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFOSR/NP Bolling AFB DC 20332-6448 | | | 11. SUPPLEMENTARY NOTES | |
| 12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited. | | | 12b. DISTRIBUTION CODE | |
| 13. ABSTRACT (Maximum 200 words) It was attempted to deposit hard carbon films using the ionized cluster beam deposition method with organic materials. The principle idea was to have the organic molecules to decompose on impact with the substrate. A major problem involved the decomposition of organic starting material in the crucible. It was hoped to use lower crucible temperatures to reduce decomposition. Increased crucible temperatures were eventually used to increase the deposition rate. This resulted in more hydrogen in the chamber and the 50 Lps turbomolecular pump was unable to maintain a pressure below about 8×10^{-4} torr. Changes and experiments are being made, but to date the endeavor has been unsuccessful. | | | | |
| 14. SUBJECT TERMS ion composition, depositing beam, ... | | | 15. NUMBER OF PAGES 22 | |
| 16. PRICE CODE | | | 17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED | |
| 18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED | | 19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED | | 20. LIMITATION OF ABSTRACT U SAP |

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GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to **stay within the lines to meet optical scanning requirements.**

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Block 2. Report Date. Full publication date including day, month, and year, if available (e.g. 1 Jan 88). Must cite at least the year.

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Block 5. Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

| | |
|----------------------|------------------------------|
| C - Contract | PR - Project |
| G - Grant | TA - Task |
| PE - Program Element | WU - Work Unit Accession No. |

Block 6. Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

Block 7. Performing Organization Name(s) and Address(es). Self-explanatory.

Block 8. Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

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Block 11. Supplementary Notes. Enter information not included elsewhere such as: Prepared in cooperation with...; Trans. of ..., To be published in When a report is revised, include a statement whether the new report supersedes or supplements the older report.

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NASA - NASA - Leave blank

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Block 13. Abstract. Include a brief (Maximum 200 words) factual summary of the most significant information contained in the report.

Block 14. Subject Terms. Keywords or phrases identifying major subjects in the report.

Block 15. Number of Pages. Enter the total number of pages.

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Block 20. Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.

Final Report

Grant AFOSR-89-0196

(DRUIP) Nozzle Beam Deposited Diamondlike Carbon Films

Calvin W. Lowe
Calvin W. Lowe, Sc. D.
Principal Investigator

Hampton University
Physics Department
Hampton, VA 23668

We have attempted to deposit hard carbon films using the ionized cluster beam deposition method with organic materials. The principle idea was to have the organic molecules to decompose on impact with the substrate. To date, we have been unsuccessful in this endeavor. The difficulties encountered and our proposed solutions are detailed below.

A major problem involved the decomposition of our organic starting material in the crucible. This was anticipated from the beginning of the project. We hoped to use lower crucible temperatures to reduce decomposition. However, we eventually increased crucible temperatures to increase the deposition rate. This resulted in more hydrogen in the chamber and our 50 l/s turbomolecular pump was unable to maintain a pressure below about 8×10^{-4} torr.

The first order fix to this problem was to install a CTI cryotorr-100 cryopump. This increased the overall pumping speed by a factor of seven and allowed us to pump water at 1100 l/s and hydrogen at about 500 l/s. Neither water nor hydrogen could be pumped with the turbomolecular pump. This problem also revealed

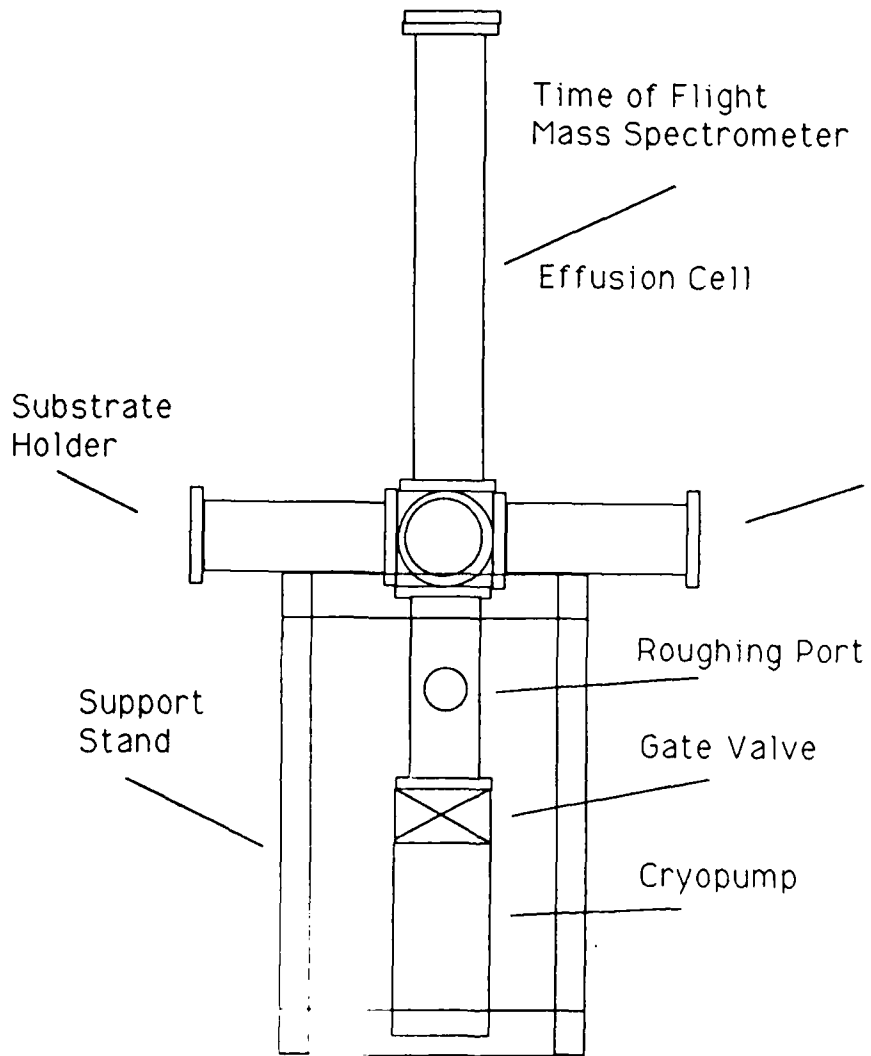


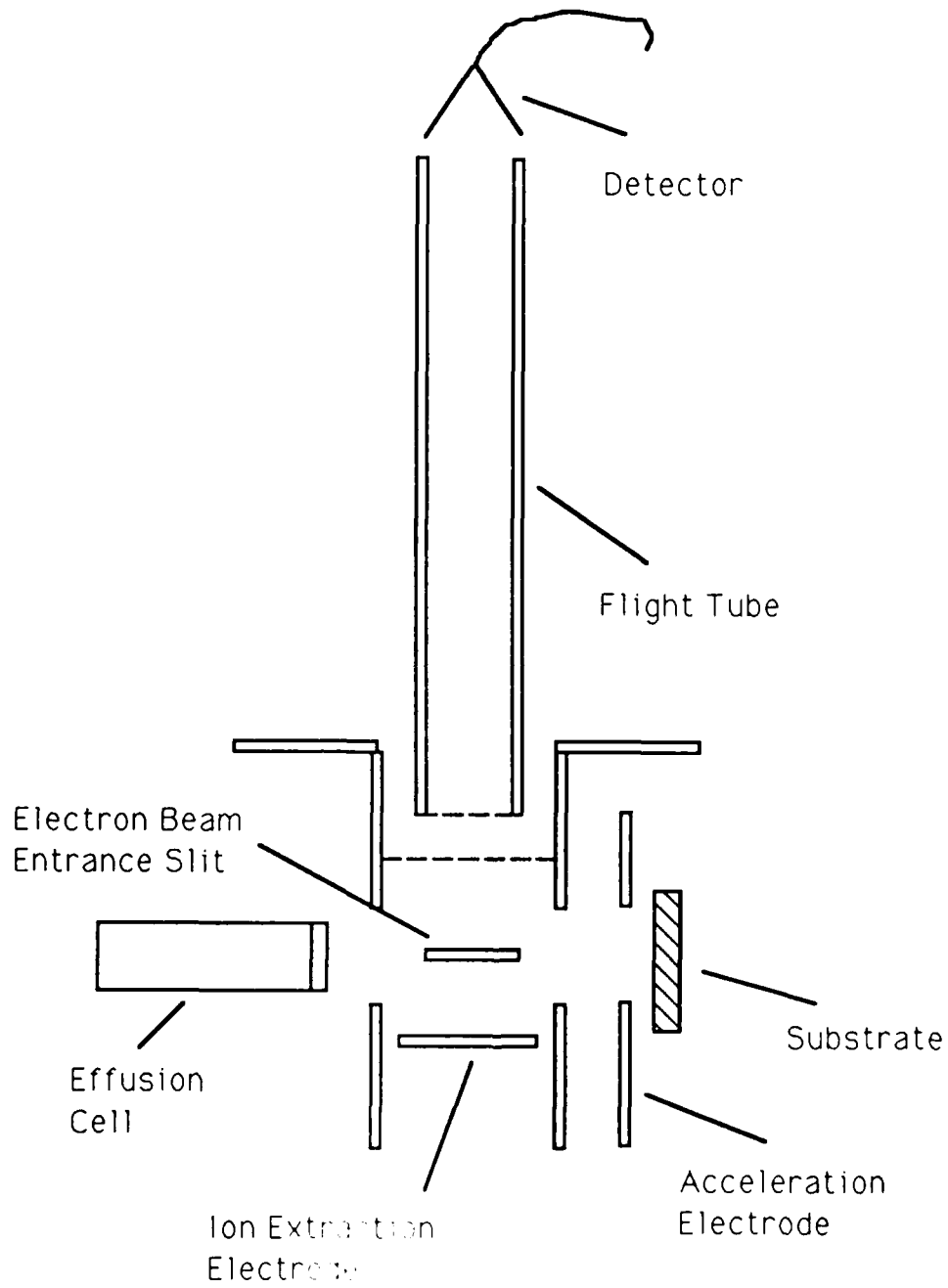
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some shortcomings of our ionized cluster beam source design.

Larger aperture nozzles were needed to increase the deposition rate with a minimal increase in the crucible temperature. We also found that varying the acceleration voltage did not have an appreciable affect on film growth. This was observed to be independent of the operating parameters of the ionization stage. As a result, we believe it likely that there are few ionized clusters in the beam. The source has been redesigned to move the ionization stage closer to the nozzle exit. The greater beam density at this location will allow more effective ionization to occur. We are also adapting a time of flight mass spectrometer to the station to carry out real time analysis of the ion composition and percentage of the depositing beam.

Drawings of the new source and vacuum chamber are attached. We are currently in the process of assembling the new station and hope to present some results at the American Physical Society meeting in Cincinnati, OH in March 1991. We have enlisted the aid of one undergraduate volunteer on this project and are currently seeking funding to extend the work into the area of optically nonlinear organic film growth and device fabrication.





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January 12, 89

5-22350-520

AFOSR
Physics (Lowe-~~HASS~~)

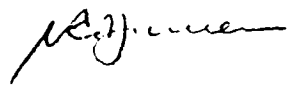
Bertan Associates, Inc.

121 New South Road

Hicksville, NY 11801

1 ea IB-30 30kV ion beam power supply with
floating bias and filament power supplies

5 9 7 5 00



Calvin W. Lowe

✓

January 12, 89

5-23350-520

Physics (Lowe-AFOSR)

Insulator Seal, Inc.

P.O. Box 57016

Hayward, CA 94545

| | | | | | |
|---|----|------------|------------------------------|-----|----------|
| 3 | ea | 601B034S-1 | 15 kV UHV-SHV feedthroughs | 195 | 5 8 5 00 |
| 2 | ea | 601B1314-1 | T.C. + Power UHV feedthrough | 151 | 3 0 2 00 |
| 2 | ea | 601A0201-3 | 1 kV Weldable feedthrough | 18 | 3 6 00 |

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TOTAL

9 2 3 00

Calvin W. Lowe

217 ✓

January 12, 89

5-22350-5

Physics (Lowe-AFOSR)

IDC Vacuum Products Corp.

23842 Cabot Blvd

Hayward, CA 94545-1651

Page 1 of 3

| | | | | |
|---|-----|--|-----|------------|
| 4 | ea | LN-133 LN ₂ -UHV feedthrough on 1 1/3" flange | 125 | 5 0 0 00 |
| 1 | ea | Custom 6" Flange w/7 miniflanges as per drawing | | 9 1 0 00 |
| 1 | ea | Custom 6" Flange w/6 miniflanges as per drawing | | 8 1 5 00 |
| 1 | ea | BRM-133 Rotary motion feedthru on 1 1/3" flange | | 3 3 5 00 |
| 1 | ea | CU 400-6 6 way cube w/6" flanges | | 2 5 0 0 00 |
| 1 | ea | VP-400 Zero Profile Viewport | | 3 3 5 00 |
| 2 | ea | F600000 6" Blank UHV Flange | 65 | 1 8 8 00 |
| 3 | ea | GK-400V Viton Gaskets | 16 | 1 2 8 00 |
| 5 | pkg | BA-200 Bolt Sets | 22 | 1 1 0 00 |

Reference

Calvin W. Lowe

January 12, 39

5-22350-520

Physics (Lowe-AFUSK)

MDC Vacuum Products Corp.

23842 Cabot Blvd.

Hayward, CA 94545-1651

Page 2 of 3

| | | | | |
|----|----|---|----------------|---------------------|
| 1 | ea | 600 x 275 6" to 2 3/4" adapter flange | 1 0 0 00 | |
| 1 | ea | 150X 2 3/4" flanged bellows | 1 1 0 00 | 1 1 0 00 |
| 1 | ea | K150 x 275 NW40 to 2 3/4" adapter flange | 6 5 00 | <i>refuse.</i> |
| 1 | ea | K150-C NW40 Clamp | 8 25 | |
| 1 | ea | K150-CR NW40 Centering Ring | 9 00 | |
| 1 | ea | 275 x 133 2 3/4" to 1 1/3" adapter flange | 5 5 00 | |
| 1 | ea | 075 x 2 1 1/3" nipple | 4 5 00 | |
| 15 | ea | F133000 1 1/3" Coverplates | 11.00 1 6 5 00 | |
| 4 | ea | BA-075 Bolt Sets | 11 4 4 00 | |

Calvin W. Love

January 12, 39

5-22350-520

Physics (Lowe-AFOSR)

MDC Vacuum Products Corp.

23842 Cabot Blvd.

Hayward, CA 94545-1651

Page 3 of 3

| | | | | |
|---|----|------------------------------|-----------|----------------------|
| 4 | ea | GK-075V 1 1/3" Viton Gaskets | 12 4 8 00 | 12 4 8 00 |
| 1 | ea | BA-150 Bolt Set | 1 3 00 | |
| 4 | ea | GK-100V Viton Gaskets | 14 5 6 00 | <i>refuse</i> |
| 1 | ea | 3" UHV nipple | 2 3 0 00 | |

January 20, 39

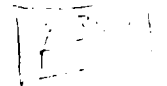
Physics (Lowe-AFOSR)

5-22350-520

Production Supply Co. Inc of VA

600 Woodlake Drive

Chesapeake, VA



| | | | |
|----|----|---------------------|----------|
| 1 | ea | 4'x8'x1/8" Al Sheet | 1 6 4 35 |
| 1 | ea | 4'x8'x1/2" Al Sheet | 3 2 2 00 |
| 25 | ft | 1"x1"x1/8" Al angle | 3 2 00 |
| 12 | ft | 1" diameter Al bar | 4 8 25 |

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|-------|--|--|----------|
| TOTAL | | | 5 6 6 60 |
|-------|--|--|----------|

Calvin W. Love

January 27, 89

Physics (Lowe-AFOSR)

5-22350-520

OMEGA Engineering, Inc.

P.O. Box 4047

Stanford, CT 06907-0047

| | | | | |
|----|----|----------------------------------|--------|----------|
| 2 | ea | CN30UKC Temperature Controller | 199.00 | 3 9 8 00 |
| 10 | ea | Bare-20-K-12 Type K Thermocouple | 6.00 | 6 0 00 |

~~199.00~~
~~6.00~~
Revised

TOTAL

4 4 8 00

Calvin L. Lowe

HAMPTON UNIVERSITY REQUISITION

ORDER NO. _____

TO: PURCHASING AGENT

DATE Feb. 21 19 89

ORDER FOR Physics (Lowe-AFOSR) DEPT.


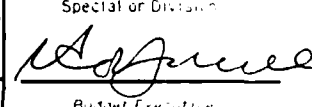
ACCOUNT NO. 5-22350-520

ORDER TO BE FILLED BY Kimball Physics Inc.

ADDRESS Kimball Hill Road

Wilton, NH 03086-9742

Page 1 of 2

| REQUEST | | DESCRIPTION | UNIT PRICE | AMOUNT | | | APPROVALS: | |
|----------|------|------------------|------------|--------|---|---|------------|---|
| QUANTITY | UNIT | | | | | | | |
| 1 | pkg | Al2O3-TU-C-500 | 17.00 | | 1 | 7 | .00 |  Special or Division  Budget Executive _____ Purchasing Agent _____ Budget Control _____ Business Manager |
| 2 | pkg | Al2O3-TU-C-250 | 17.00 | | 1 | 7 | .00 | |
| 3 | pkg | Al2O3-TU-C-125 | 17.00 | | 1 | 7 | .00 | |
| 2 | pkg | Al2O3-SP-C-200 | 17.00 | | 1 | 7 | .00 | |
| 3 | pkg | Al2O3-SP-C-025 | 17.00 | | 1 | 7 | .00 | |
| 3 | pkg | Al2O3-SP-C-050 | 17.00 | | 1 | 7 | .00 | |
| 1 | pkg | SS-WR-1500/031 | 17.00 | | 1 | 7 | .00 | |
| 6 | pkg | SS-PL-C7X7-B | 17.00 | | 1 | 7 | .00 | |
| 2 | pkg | SS-PL-C7X7-R1500 | 17.00 | | 1 | 7 | .00 | |
| 2 | pkg | SS-CY-1500/3000 | 17.00 | | 1 | 7 | .00 | |



PRODUCTION
INSTRUCTION

JOB NO. _____
STOCK

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Full Signature

PAGE 2 OF 2

Wilton, NH 03086-9742

| REQUEST | | DESCRIPTION | UNIT PRICE | AMOUNT | | | APPROVALS: | |
|----------|------|-----------------|------------|--------|----------|----------|------------|---|
| QUANTITY | UNIT | | | | | | | |
| 2 | pkg | SS-LR-C | 17.00 | | 1 | 7 | .00 |  Special or Division  Budget Executive |
| 1 | pkg | SS-MS-0-80/250 | 17.00 | | 1 | 7 | .00 | |
| 1 | pkg | SS-MN-0-80 | 17.00 | | 1 | 7 | .00 | |
| 1 | pkg | SS-CY-1500/1500 | 17.00 | | 1 | 7 | .00 | |
| | | TOTAL | | | 5 | 1 | 0 | .00 |

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REQUISITION

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TO: PURCHASING AGENT


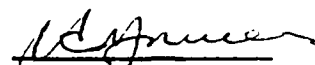
DATE March 9 19 89

ORDER FOR Physics (Lowe-AFOSR) DEPT.

ACCOUNT NO. 5-22350-522

ORDER TO BE FILLED BY Priest Electronics, INC.

ADDRESS 6431 Tidewater Drive
P. O. Box 7225
Norfolk, VA 23509-0225

| REQUEST | | DESCRIPTION | UNIT PRICE | AMOUNT | | | APPROVALS: |
|----------|------|------------------------------------|------------|--------|-----|-----|---|
| QUANTITY | UNIT | | | | | | |
| 1 | ea | SOLA 84-15-2110 solid power supply | 87 | | 87 | .00 |  _____ Special or Division  _____ Budget Executive _____ Purchasing Agent _____ Budget Control _____ Business Manager |
| 1 | ea | Staco 1010 variable transformer | 59 | | 59 | .00 | |
| 4 | ea | BUD SFA-1833 surface shield panel | 70 | | 38 | .80 | |
| 10 | ea | GC 35-064 SPST toggle switch | 1.50 | | 15 | .00 | |
| 1 | ea | 44-234 BNC crimping tool | 19.25 | | 19 | .25 | |
| | | TOTAL | | | 219 | .05 | |
| | | | | | | | |
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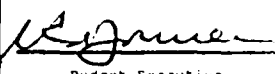
ORDER FOR Physics (Lowe-AFOSR) DEPT.

ACCOUNT NO. 5-22350-522

ORDER TO BE FILLED BY Small Parts INC.

ADDRESS 6891 N. E. Third Ave.
PO Box 381966
Miami, FL 33238-1966

Page 1 of 3

| REQUEST | | DESCRIPTION | UNIT PRICE | AMOUNT | | | APPROVALS: |
|----------|------|----------------------------------|------------|--------|-----|-----|---|
| QUANTITY | UNIT | | | | | | |
| 1 | ea | C-CX-16-C 16 mesh SS wire cloth | 29.50 | | 2 9 | .50 |  Special or Division  Budget Executive _____ Purchasing Agent _____ Budget Control _____ Business Manager |
| 1 | pkg | C-KWKC-2 1/8" cable ties 25/pkg | 7.93 | | 7 | .93 | |
| 1 | pkg | C-KWKC-4 1/4" cable ties 25/pkg | 9.03 | | 9 | .03 | |
| 1 | pkg | C-MX-080-2-B 1/8x0-80 SS screws | 10.00 | | 1 0 | .00 | |
| 1 | pkg | C-MX-080-3-B 3/16x0-80 SS screws | 10.00 | | 1 0 | .00 | |
| 1 | pkg | C-MX-080-4-B 1/4x0-80 SS screws | 10.00 | | 1 0 | .00 | |
| 1 | pkg | C-MX-080-6-B 3/8x0-80 SS screws | 16.25 | | 1 6 | .25 | |
| 1 | pkg | C-MX-080-8-B 1/2x0-80 SS screws | 16.25 | | 1 6 | .25 | |
| 1 | pkg | C-MX-080-12-B 3/4x0-80 SS screws | 16.25 | | 1 6 | .25 | |
| 3 | ea | C-TRX-080-24 24"x0-80 thread rod | 10.00 | | 3 0 | .00 | |

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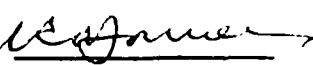
ORDER FOR _____ DEPT. _____

ACCOUNT NO. _____

ORDER TO BE FILLED BY _____

ADDRESS _____

Page 2 of 3

| REQUEST | | DESCRIPTION | UNIT PRICE | AMOUNT | | | APPROVALS: | |
|----------|------|---------------------------------------|------------|--------|---|---|------------|---|
| QUANTITY | UNIT | | | | | | | |
| 10 | pkg | C-WX-0 size 0 SS flat washers 100/pkg | 3.50 | | 3 | 5 | .00 |  _____ Special or Division  _____ Budget Executive _____ Purchasing Agent _____ Budget Control _____ Business Manager |
| 3 | pkg | C-HNX-080 0-80 SS nuts 100/pkg | 7.35 | | 2 | 2 | .05 | |
| 1 | kit | C-ORBK-500 O-ring assortment kit | 41.87 | | 4 | 1 | .87 | |
| 1 | ea | C-RP-1 angled retaining ring pliers | 13.86 | | 1 | 3 | .86 | |
| 2 | ea | C-HM-906 inspection mirror | 4.07 | | | 8 | .14 | |
| 2 | ea | C-MT-10 carbide scriber | 4.80 | | | 9 | .60 | |
| 1 | ea | C-RUX-1 24" ruler w/ 1/64" markings | 10.34 | | 1 | 0 | .34 | |
| 4 | ea | C-RUX-6 6" ruler w/ 1/32" markings | 2.50 | | 1 | 0 | .00 | |
| 2 | ea | C-HM-204 wire prong holders | 5.62 | | 1 | 1 | .24 | |
| 1 | set | C-TPS-28 transfer punch set-inch | 59.33 | | 5 | 9 | .33 | |

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DATE _____ 19 ____


ORDER FOR _____ DEPT. _____

ACCOUNT NO. _____

ORDER TO BE FILLED BY _____

ADDRESS _____

Page 3 of 3

| REQUEST | | DESCRIPTION | UNIT PRICE | AMOUNT | | | | APPROVALS: |
|----------|------|-------------------------------------|------------|--------|---|---|-------|---|
| QUANTITY | UNIT | | | | | | | |
| 1 | set | C-CP-1 7/8"x1.5" containers 100/set | 23.99 | | 2 | 3 | .99 |  _____ Special or Division |
| 10 | ea | C-RPT-12 24" x .75" plastic tubes | 0.96 | | | 9 | .60 | |
| | | TOTAL | | | 4 | 1 | 0 .23 | |
| | | | | | | | | _____ Budget Executive |
| | | | | | | | | _____ Purchasing Agent |
| | | | | | | | | _____ Budget Control |
| | | | | | | | | _____ Business Manager |

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 Full Signature

HAMPTON UNIVERSITY

REQUISITION

ORDER NO. _____

TO: PURCHASING AGENT

DATE March 20, 19 89


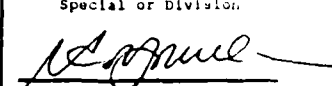
ORDER FOR Physics (Lowe-AFOSR) DEPT.

ACCOUNT NO. 5-22350-520

ORDER TO BE FILLED BY ELVAC Mid-Atlantic

ADDRESS P.O. Box 8146

Fredericksburg, VA 22404

| REQUEST | | DESCRIPTION | UNIT PRICE | AMOUNT | | | APPROVALS: |
|----------|------|-----------------------------------|------------|--------|-----|-----|--|
| QUANTITY | UNIT | | | | | | |
| 1 | ea | 600-275-150Z reducer flange | 95 | | 9 5 | .00 |  Special or Division |
| 1 | ea | 275-3/4 QD CF to quick disconnect | 80 | | 8 0 | .00 | |
| 1 | ea | FTNC-6-1502-CF LN cold trap | 585 | 5 | 8 5 | .00 | |
| | | TOTAL | | 7 | 6 0 | .00 |  Budget Executive |
| | | | | | | | Purchasing Agent |
| | | | | | | | Budget Control |
| | | | | | | | Business Manager |

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TO: PURCHASING AGENT

DATE 5/10 19 89



ORDER FOR Physics (Lowe-AFOSR) DEPT.

ACCOUNT NO. 5-22350-520

ORDER TO BE FILLED BY Precision Sales Company

ADDRESS 104 W. Joppa Road

Baltimore, MD 21204

| REQUEST | | DESCRIPTION | UNIT PRICE | AMOUNT | | | | | APPROVALS: |
|----------|------|------------------------------|------------|--------|---|---|---|-----|--|
| QUANTITY | UNIT | | | | | | | | |
| 1 | ea | model 125 power supply | 2200 | 2 | 2 | 0 | 0 | .00 |  Special or Division |
| 1 | ea | model THP tweezer hand piece | 410 | | 4 | 1 | 0 | .00 | |
| 1 | ea | model PHP probe hand piece | 375 | | 3 | 7 | 5 | .00 | |
| | | | | | | | | | |
| | | TOTAL | | 2 | 9 | 8 | 5 | .00 |  Budget Executive |
| | | | | | | | | | Purchasing Agent |
| | | | | | | | | | Budget Control |
| | | | | | | | | | Business Manager |

PRODUCTION

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TO: PURCHASING AGENT

DATE 5/16 19 89



ORDER FOR Physics (Lowe-AFOSR) DEPT.

ACCOUNT NO. 5-22350-520

ORDER TO BE FILLED BY Klinger Scientific

ADDRESS 999 Stewart Ave

Garden City, NY 11530

| REQUEST | | DESCRIPTION | UNIT PRICE | AMOUNT | | | | | APPROVALS: |
|----------|------|----------------------------|------------|--------|---|---|---|-----|--|
| QUANTITY | UNIT | | | | | | | | |
| 1 | ea | 354483 rotation stage | 3035 | 3 | 0 | 3 | 5 | .00 |  Special or Division  Budget Executive |
| 1 | ea | 385900 incremental encoder | 395 | | 3 | 9 | 5 | .00 | |
| 1 | ea | KE30014N motor controller | 1950 | 1 | 9 | 5 | 0 | .00 | |
| TOTAL | | | | 5 | 3 | 8 | 0 | .00 | |
| | | | | | | | | | Purchasing Agent |
| | | | | | | | | | Budget Control |
| | | | | | | | | | Business Manager |

PRODUCTION
 INSTRUCTION

JOB NO. _____
 STOCK

ORDERED BY Cabriel Lowe
 Full Signature

HAMPTON UNIVERSITY

REQUISITION

ORDER NO. _____

TO: PURCHASING AGENT

DATE June 5 19 89


ORDER FOR Physics (LOWE-AFOSR) DEPT.

ACCOUNT NO. 5-22350-520

ORDER TO BE FILLED BY Bertan Associates, Inc.

ADDRESS 121 New South Rd.

Hicksville, NY 11801

| REQUEST | | DESCRIPTION | UNIT PRICE | AMOUNT | | | | APPROVALS: |
|----------|------|------------------------------|------------|--------|---|---|-----|---|
| QUANTITY | UNIT | | | | | | | |
| 1 | ea | High voltage cable for IB-30 | 400 | 4 | 0 | 0 | .00 |  _____ Special or Division |
| | | PIN-0221301-000 | | | | | | |
| | | TOTAL | | 4 | 0 | 0 | .00 | _____ Budget Executive |
| | | | | | | | | _____ Purchasing Agent |
| | | | | | | | | _____ Budget Control |
| | | | | | | | | _____ Business Manager |

PRODUCTION
 INSTRUCTION

JOB NO. _____
 STOCK

ORDERED BY Calvin W. Lowe
 Full Signature

Purchasing Agent,

This cable is specially designed with a power supply we ordered from Bertan, Inc. Thus, we request a sole source purchase.

HAMPTON UNIVERSITY

REQUISITION

ORDER NO. _____

TO: PURCHASING AGENT


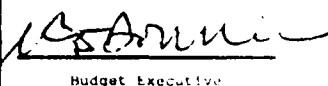
DATE June 5 19 89

ORDER FOR Physics (LOWE-AFOSR) DEPT.

ACCOUNT NO. 5-22350-520

ORDER TO BE FILLED BY National Instruments

ADDRESS 12109 Technology Blvd.
Austin, TX 78727-6204

| REQUEST | | DESCRIPTION | UNIT PRICE | AMOUNT | | | | APPROVALS: |
|----------|------|---------------------------|------------|--------|---|---|-----|---|
| QUANTITY | UNIT | | | | | | | |
| 1 | ea | 776156-01 NB-GPIB board | | | | | |  _____ Special or Division |
| | | for Macintosh II computer | 495 | 4 | 9 | 5 | .00 | |
| 2 | ea | 763001-01 GPIB cable | 75 | 1 | 5 | 0 | .00 |  _____ Budget Executive |
| 2 | ea | 763061-03 GPIB cable | 105 | 2 | 1 | 0 | .00 | |
| | | TOTAL | | 8 | 5 | 5 | .00 | _____ Purchasing Agent |
| | | | | | | | | _____ Budget Control |
| | | | | | | | | _____ Business Manager |

PRODUCTION
INSTRUCTION

JOB NO. _____
STOCK

ORDERED BY Calvin W. Lowe
Full Signature

Purchasing Agent,

I request a sole source purchase of these items. We have previously bought from this company and the requested items are compatible with the existing equipment.

