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PROCEEDINGS

6-11-92

GRANT NO. N00014-92-J-1733

National Center for Manufacturing Sciences, Inc.
900 Victors Way
Ann Arbor, Michigan 48108-1779

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DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL RESEARCH
ARLINGTON, VIRGINIA 22217-5000

IN REPLY REFER TO

1512B:JGW

JUN 11 1992

National Center for Manufacturing Sciences
900 Victors Way
Ann Arbor, MI 48108-1779

Gentlemen:

Enclosed for your retention is one copy of Grant Number N00014-92-J-1733 which I have signed for the Government. The grant document does not require your signature.

Please acknowledge receipt of this grant by promptly signing and returning the enclosed copy of this transmittal letter to this office to the attention of Code 1512B:JGW. Keep this original letter for your records.

In the event of any disagreement with the grant provisions, you must notify this office within thirty (30) days of the date of this letter. If you have any questions, please contact Jon G. Wester by telephone on (703) 696-2600.

Sincerely,

Grants Officer

Enclosure

Acknowledgement of Receipt

By: *M. J. [Signature]*

Date: 8-15-92

DIRECTOR, NCMIS
R&D CONTRACTS

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National Center for Manufacturing Sciences

900 Victors Way
Ann Arbor, MI
48108-1779

August 25, 1992

Mr. Jon Wester
Office of Naval Research
Contracts Division, Code 151
800 North Quincy Street
Arlington, VA 22217-5000

Subject: Grant No. N00014-92-J-1733

Dear Mr. Wester:

Enclosed, in accordance with the terms and conditions of the subject grant, are the Proceedings (with a completed Document Control Data -- R&D form [SF298]). Also enclosed is the Acknowledgment of Receipt requested by your letter of June 11.

Please do not hesitate to call if you have any questions or require additional information.

Sincerely,



Michael Szczepanek
Director R&D Contracts

Enclosures

cc: ONR (w/3 copies of proceedings & SF298)
DTIC (w/1 copy of proceeding & SF298)
W. Collins, NCMS

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ABSTRACT: The NCMS and University Science Partners Holdings, Inc. (USPH) have previously agreed to work together to transfer eight key technologies from the E. O. Paton Electric Welding Institute (PWI) and the Dnepropetrovsk Metallurgical Institute (DMI) in Ukraine. The Ukrainian technologies have been well chosen and are all state-of-the-art in areas where the United States does not have a technical lead. The Ukrainian technologies are mature and attractive to the National Laboratories and sophisticated U.S. Manufacturers. The technologies of particular interest are: Electron Beam Carbides and Diamond-Like Carbon Coatings, Electron Beam Fiber Coating, Electron Beam Thermal Barrier Coatings, Gyrotron Processing of Electronic Circuit Boards, Microlaminates, Anisotropic Porous Materials, PICT-Iron and Diamond Honing.

Through discussions with the technology inventors, Government agencies and industry, the apparent need for first hand information to be presented to the NCMS membership, U.S. Government and industry was discovered. Workshops covering the technical areas identified in Ukraine were planned and executed during the months of March, April and May 1992.

UKRAINIAN TECHNOLOGY TRANSFER PROJECT

05/15/92

1Q92 SUMMARY UPDATE

Following is a summary of events that detail the current status and future plans for the Ukrainian Technology Transfer Project. This project complies in full with the Technology Sourcing Operating Plan released 3 May 1992, per item 2, Global Technology Sourcing, and the Milestones & Status section of the plan regarding 1Q92 and 2Q92.

The intent of this summary is to provide an update on the continued exploitation of a unique opportunity; developing technical relationships with leading Ukrainian Research Institutes and transferring the Ukrainian technology to the NCMS industrial and government membership.

The NCMS and University Science Partners Holdings, Inc. (USPH) have previously agreed to work together to transfer eight key technologies from the E. O. Paton Electric Welding Institute (PWI) and the Dnepropetrovsk Metallurgical Institute (DMI) in Ukraine. The Ukrainian technologies have been well chosen and are all state-of-the-art in areas where the United States does not have a technical lead. The Ukrainian technologies are mature and attractive to the National Laboratories and sophisticated US Manufacturers. The technologies of particular interest are: Electron Beam Carbides and Diamond-Like Carbon Coatings, Electron Beam Fiber Coating, Electron Beam Thermal Barrier Coatings, Gyrotron Processing of Electronic Circuit Boards, Microlaminates, Anisotropic Porous Materials, PICT-Iron and Diamond Honing.

Working through the NCMS on a collaborative basis, NCMS member companies are developing technical and commercial relationships with the leading Ukrainian Institutes. A critical NCMS objective in this endeavor is to install prototype facilities with these technologies in the United States promptly.

USP Holdings, Inc. (USPH), is a corporation involved in the business of technology transfer and has been instrumental in obtaining various manufacturing technologies from research institutes in Ukraine, formerly the Union of Soviet Socialist Republics (USSR) and has been active in the formation of subsidiary ventures to promote the commercialization of those technologies. USPH is a NCMS contractor for the Ukrainian Technology Transfer Project.

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UKRAINIAN TECHNOLOGY TRANSFER PROJECT GOAL:

Establish a collaboration between NCMS member organizations, Government Agencies and the NCMS to exploit a unique opportunity in developing technical relationships with leading Ukrainian Research Institutes. The measure of project success is determined by the percentage and timing of technology implementation into the production flow on NCMS member company factory floors. Milestones to measure technology transfer to industry will be monitored by the number of equipment purchases and the purchaser, as well as process and technology licensing.

SUMMARY OF UKRAINE TRIP:

The NCMS/USPH sponsored mission to Ukraine took place during the weeks of 26 January 1992 and 2 February 1992. Representatives from United Technologies Corporation, Pratt & Whitney, the Naval Research Laboratory, USPH and NCMS participated.

The E. O. Paton Electric Welding Institute (PWI), Dnepropetrovsk Metallurgical Institute (DMI) and the Institute for Superhard Materials (ISM) were visited. Specific areas of interest included Electron Beam processing of carbide coatings, coating of fibers and thermal barrier coatings for turbine blades (PWI); gyrotron microwave processing (PWI); anisotropic porous materials - GASAR (DMI); PICT-Iron (DMI); and diamond honing (ISM).

Electron Beam coatings are divided into three categories: namely carbide coatings, fiber coatings and thermal barrier coatings. All seven areas indicated above are discussed below.

Electron Beam Physical Vapor Deposition of Carbides:

- **Technical Objective:** EB-PVD process for commercial carbide coatings.
- **Applications:** Bi-metallic discs for slitters and milling cutters, TiC coatings on steel cutting tools, diamond-like carbon, vapor deposited copper on ceramic capacitor substrates (eliminates need for expensive silver electrodes), laminates and metal /ceramic composites.
- **Technical Benefits Over Existing Art:** High deposition rates, high properties.
- **Project Targets:** Optimize strength, hardness, toughness, wear resistance and conductivity of coatings.
- **Technology Transfer Objectives:**
 - Bring equipment to North America for safety upgrades and production of samples.
 - License processes.
 - Member company purchase of research units.

Electron Beam Physical Vapor Deposition on Fibers:

- **Technical Objective:** Electron Beam - Physical Vapor Deposition Process for commercial fiber and Metal Matrix Composite coatings (MMC).
- **Applications:** Dispersion strengthened material for conductor applications (i.e.: Cu5Mo, PtZrO2).
- **Technical Benefits Over Existing Art:** Fast continuous process; superior wetting and thermal stability in matrix.
- **Project Targets:** Optimize coating composition, thickness, coverage and deposition rate.
- **Technology Transfer Objectives:**
 - Bring equipment to North America for safety upgrades and production of
 - License processes.
 - Member company purchase of research units.

Electron Beam Physical Vapor Deposition of Thermal Barrier Coatings:

- **Technical Objective:** Electron Beam - Physical Vapor Deposition Process for Thermal Barrier Coatings on super alloys and gas turbine components.
- **Applications:** Vapor deposition of metal and ceramic coatings to protect gas turbine blades.
- **Technical Benefits Over Existing Art:** Longer life between engine overhauls, therefore, reduced cost of ownership currently estimated at 2X).
- **Project Targets:** Optimize compositions, thickness and number of layers used on blades.
- **Technology Transfer Objectives:**
 - Bring equipment to North America for safety upgrades and production of samples.
 - License processes.
 - Member company purchase of research

Gyrotron Microwave Processing:

- **Technical Objective:** Fast, continuous clean process for thick films and bonding of circuit boards.
- **Applications:** Circuit boards, windows, thick films on glass (i.e.: automobile defroster), thick films on polymer (i.e.: Cu leads on PWB), thick films on ceramic; and solder paste.
- **Technical Benefits Over Existing Art:** Lower cost paste, lower operating and/or cure temperature, lower pollution process (no electrolytes, low Pb).
- **Project Targets:** Optimize gyrotron processing parameters of electronic components. Optimize adhesives and pastes.
- **Technology Transfer Objectives:**
 - Bring equipment to North America for safety upgrades and production of samples.
 - LANL as beta site for gyrotron safety/control upgrade and CRADA.
 - Member company purchase of research units.

Anisotropic Porous Materials:

- **Technical Objective:** Optimize process for commercial production of unique materials.
- **Applications:** Ni tubes of insulin filters, Ni filters for chemical plants (in service one year, replaces sintered Cu filters that last one week), bronze bearings for food processing (prevents food contamination), ceramic catalyst support (high temperature application), Mg space structures.

- **Technical Benefits Over Existing Art:** Less wear, high strength-to-weight, more damping, better filter, high conductivity.
- **Project Targets:** Optimize strength, thermal conductivity, wear resistance and damping.
- **Technology Transfer Objectives:**
 - Bring equipment to North America for safety upgrades and production of samples.
 - License processes.
 - Member company purchase of research units.

PICT-Iron:

- **Technical Objective:** Optimize processing and heat treatment for various applications.
- **Applications:** Cam rods, bearings, rolls, grinding balls, knives, etc.
- **Technical Benefits Over Existing Art:** Low cost, low wear, high hardness. Does not require special equipment or unconventional operations. 3-4X lifetime improvement on cast iron rolls.
- **Project Targets:** Optimize strength, hardness, toughness and wear resistance damping.
- **Technology Transfer Objectives:** License process to US. producer.

Diamond Honing:

- **Technical Objective:** Qualify honing for machining wear surfaces.
- **Applications:** Cylinders, liners in a variety of engines, pumps and compressors.
- **Technical Benefits Over Existing Art:** Provide engineered surfaces with less wear, lower friction, less oil and gas.
- **Project Targets:** Advertised production ready device. Demonstrate 5X increase in service life of honed parts.
- **Technology Transfer Objectives:**
 - Demonstrate equipment at ITI.
 - Machine samples for member companies.
 - Market tools.

The information illustrated in the seven fields of interest above were identified and focused as a result of the Ukraine trip in January and February 1992. A follow-up trip is scheduled for June and July 1992 to further focus technology samples and business direction.

UKRAINIAN SCIENCE WORKSHOPS:

One result of the trip to Ukraine, and through subsequent discussions with the technology inventors, was the apparent need for first hand information to be presented to the NCMS membership, US. Government and industry. Workshops covering the technical areas identified in the Ukraine Trip section were planned and executed during the months of March, April and May 1992 per the following plan:

| <u>WORKSHOP</u> | <u>LOCATION</u> | <u>ATL</u> | <u>DATE</u> |
|---|---------------------------------|-------------------|--------------------|
| • Anisotropic Porous Materials Workshop | Marriott @ National Airport | 35 | 3/24/92 |
| • Anisotropic Porous Materials Workshop | Wright Patterson Air Force Base | 25 | 3/26/92 |
| • Electron Beam & Diamond Honing Workshop | Naval Surface Warfare Center | 27 | 4/13/92 |
| • Electron Beam & Diamond Honing Workshop | Wright Patterson Air Force Base | 22 | 4/15/92 |
| • Gyrotron Microwave Processing Workshop | Naval Surface Warfare Center | 23 | 5/5/92 |
| • Gyrotron Microwave Processing Workshop | Wright Patterson Air Force Base | 22 | 5/7/92 |

These workshops were co-sponsored by the NCMS and the Office of the Chief of Naval Research. Following is a list of NCMS members, Government Agencies and industrial companies that attended the workshops:

GOVERNMENT ORGANIZATIONS

CDNSWC
Department of Commerce
DTRC
FSTC
Joint Economic Committee
NAEC
NAS
NASA
NASP
NAWC
NIST
NRL
NSWC
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OCNR
OSD
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INDUSTRIAL ORGANIZATIONS

3M
Armco
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EG&G
Fiber Materials Inc.
General Dynamics
General Electric
General Motors- Allison / Harrison
Howmet
IDA
Martin Marietta
Space Age Concepts
Sverdrup
University of Maryland
UTC; P&W
Varian

All costs associated with the Ukrainian Technology Transfer Workshops were completed in compliance with the approved proposal entitled: "A Technical and Cost Proposal for Importing Ukrainian Technologies to the U.S. Navy and North American Industry".

PART 53 - FORMS

53.301-288

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