

Moore, Marsha M.

From: Justice, George
Sent: Thursday, June 28, 2012 12:57 PM
To: Churchill, Robert
Subject: Re: NSEI

Bob,

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So--what are the odds of pulling this off?

Thanks for all your work,
George

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George Justice
Dean of the Graduate School
Vice Provost for Advanced Studies
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573-884-1402
JusticeG@missouri.edu

On Jun 26, 2012, at 10:14 AM, Churchill, Robert wrote:

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From: Justice, George
Sent: Tuesday, June 26, 2012 9:06 AM
To: Churchill, Robert
Subject: Re: NSEI

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On Jun 26, 2012, at 8:33 AM, Churchill, Robert wrote:

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Moore, Marsha M.

From: Justice, George
Sent: Thursday, June 28, 2012 12:58 PM
To: Dean, Kenneth D.
Subject: Fwd: NSEI

FYI and for space files...

Begin forwarded message:

From: George Justice <justiceg@missouri.edu>
Subject: Re: NSEI
Date: June 28, 2012 12:56:49 PM CDT
To: "Churchill, Robert" <ChurchillR@health.missouri.edu>

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From: Dean, Kenneth D.
Sent: Thursday, June 28, 2012 1:05 PM
To: Foster, Brian L. (Provost)
Subject: FW: NSEI

fyi

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Sent: Thursday, June 28, 2012 3:42 PM
To: Churchill, Robert
Subject: Re: NSEI

Long term I think both "Nuclear Engineering" and "Medical Physics" are going to be in flux--and I think that most new faculty would be interested in space down at the reactor. So let's not let this get in the way!

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Date: June 28, 2012 3:41:48 PM CDT
To: "Churchill, Robert" <ChurchillR@health.missouri.edu>

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From: Justice, George
Sent: Thursday, June 28, 2012 4:51 PM
To: Dean, Kenneth D.
Subject: FW: NSEI

And more. Should we talk to Brian about this now? Or let it develop as it's going?

From: <Churchill>, Robert <ChurchillR@health.missouri.edu>
Date: Thursday, June 28, 2012 4:16 PM
To: George Justice <justiceg@missouri.edu>
Subject: RE: NSEI

OK. Rich and I are working on this. we had a good meeting with the NSEI folks last week.

Robert J. Churchill, MD
Hugh E. and Sarah D. Stephenson Dean
Lodwick Distinguished Professor of Radiology
School of Medicine
University of Missouri
One Hospital Drive - DC018.00
Columbia, MO 65212
(573) 884-9080
(573) 884-4808 fax
churchillr@health.missouri.edu

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From: Attebery, Jeffrey R.
Sent: Thursday, June 28, 2012 5:34 PM
To: Hall, Robert D. (Office of Research)
Cc: Butler, Ralph; Breen, Barbara L.
Subject: RE: NSEI research project at MURR.
Attachments: RE: PRIME letter PRM-11-037; usgm1554_4389964.pdf; 00034276- Int Budget & Match.pdf; Loyalka PRIME 11-037.pdf

Dr. Hall,

Per recent discussions at MURR, we would like to accept your offer to inquire with Dr. Loyalka about the availability of funds to retrofit a beam line at MURR. That being said, here is a short synopsis per your request when I met with you and Barb Breen a few weeks ago.

- Dr. John Brockman (MURR researcher) recently initiated a work order for MURR staff to retrofit a reactor beam line. He estimates the total cost for this work to be ~\$200K. When I asked Dr. Brockman about the funding for this work, he replied that this retrofit was necessary for the research project being funded with the DOE NEUP grant (project 00034276) and he presumed that this grant would fund the retrofit. Since this grant is a NSEI administered grant, I contacted James Bennett. James replied that this grant has no budget to fund the beam line work at MURR. I obtained the attached Grant Award Summary and after a close review of the grant budget, I concur with James. However, I noticed on the attached GAS that there is \$200K in PRIME and \$200K in department cost match associated with this research project too. Thinking that one of these might be the source of funds "earmarked" to pay for the beam port retrofit, I followed up on them. What I found and confirmed with Barb Breen is that \$75K of the \$200K PRIME commitment has been transferred from the Office of Research to NSEI, and this \$200K PRIME commitment is being solely used to fund lab equipment at MURR. More specifically, Dr. Brockman, with approval from Dr. Loyalka, has already spent ~\$175K of the PRIME commitment to purchase a new ICPMS - which was recently installed at MURR. Dr. Brockman also has plans (with Loyalka approval) to procure another piece of lab equipment worth ~\$20K to be funded with PRIME. As for the \$200K department cost match, it seems that Dr. Loyalka earlier suggested these funds would come from NSEI and MURR RIF dollars applicable to the DOE NEUP grant. Unfortunately, there seems to be two concerns with this. One, I cannot find any documentation where MURR formally agreed to contribute MURR RIF or any other MURR funding toward the \$200K cost match commitment. And two, even if the RIF from all investigators was to be allocated toward the department cost match, the RIF total calculates to ~\$90K - well short of the \$200K match.

Since there seems to be some uncertainty regarding the availability of funds to pay for MURR's beam line retrofit, MURR has placed Dr. Brockman's work order on hold.

As you will see, I have attached some pertinent documents related to the synopsis. Should you need other documentation or have any questions, please let me know.

Thank you for your offer to inquire with Dr. Loyalka.

Jeff

Jeff Attebery
Asst. Director, MURR Fiscal Services
(573) 882-5269

atteberyj@missouri.edu

From: Hall, Robert D. (Office of Research)
Sent: Tuesday, June 12, 2012 8:47 AM
To: Attebery, Jeffrey R.
Subject: RE: NSEI research project at MURR.

Jeff:

That sounds fine. Ralph and Dave should be in agreement before we approach NSEI.

- Rob

Robert D. Hall, Ph.D., J.D.
Associate Vice Chancellor for Research
and Director of Compliance
Office of Research
University of Missouri
205 Jesse Hall
Columbia, Missouri 65211
Office (573) 882-9500
Facsimile (573) 884-8371
HallR@missouri.edu

CONFIDENTIALITY NOTICE: This email communication and any attachments may contain privileged information for the use of the designated recipients named above. The designated recipients are prohibited from disclosing this information to any other party without authorization and are required to destroy the information after its stated need has been fulfilled. If you are not the designated recipient, you are hereby notified that you have received this communication in error and that any review, disclosure, dissemination, distribution or copying of its contents is prohibited by federal or state law. If you have received this communication in error, please notify me immediately by telephone at (573) 882-9500 and destroy all copies of this communication and any attachments.

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From: Attebery, Jeffrey R.
Sent: Tuesday, June 12, 2012 08:20
To: Hall, Robert D. (Office of Research)
Cc: Breen, Barbara L.
Subject: NSEI research project at MURR.

Dr. Hall,

Thank you for your insight last Friday afternoon regarding the NSEI/Dr. Loyalka/Dr. Brockman research project which will utilize facilities at MURR. As you will recall, I approached Barb last week with some reservation about the DOE/NEUP grant, PRIME and PRIME match funding for this project – all of which are administered by NSEI. More specifically, I'm concerned as I can't seem to obtain clarification about which funds will cover MURR's cost of ~\$200K to retrofit a beam port.

Instead of sending you a short synopsis as a basis for you to inquire with Dr. Loyalka, would you mind if I waited on that until after I've had a chance to review all of this with Ralph Butler and Dr. Dave Robertson? I've only briefly apprised Ralph and Dave and would like to fully apprise them prior to any communication with Dr. Loyalka.

Thanks,

Jeff

Jeff Attebery

Asst. Director, MURR Fiscal Services

882-5269

atteberyj@missouri.edu

Moore, Marsha M.

From: Baldwin, Melissa Hunting
Sent: Friday, June 08, 2012 9:15 AM
To: Breen, Barbara L.; Hall, Robert D. (Office of Research)
Subject: RE: PRIME letter PRM-11-037

I have asked Dr. Loyalka what is the breakdown between NSEI and MURR for the \$200,000 and he has not replied back. I did not mention that MURR was asking about their commitment.

Melissa

From: Breen, Barbara L.
Sent: Friday, June 08, 2012 9:13 AM
To: Hall, Robert D. (Office of Research); Baldwin, Melissa Hunting
Subject: RE: PRIME letter PRM-11-037

Jeff Attebery at MURR is asking who approved for commitment of MURR funding, as Dr. Loyalka does not have authorization to commit funding on behalf of MURR. It sounds like no one did. Unless you tell me otherwise, I'll tell him we have no specific authorization from MURR.

Barb

From: Hall, Robert D. (Office of Research)
Sent: Friday, June 08, 2012 7:48 AM
To: Baldwin, Melissa Hunting; Breen, Barbara L.
Subject: RE: PRIME letter PRM-11-037

If he claims that MURR is going to provide any sort of match, we'll need confirmation from MURR.

Robert D. Hall, Ph.D., J.D.
**Associate Vice Chancellor for Research
and Director of Compliance**
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From: Baldwin, Melissa Hunting
Sent: Thursday, June 07, 2012 22:50

To: Breen, Barbara L.
Cc: Hall, Robert D. (Office of Research)
Subject: RE: PRIME letter PRM-11-037

I have searched multiple sources and I do not see where he showed a separate match for MURR.

Melissa

From: Breen, Barbara L.
Sent: Thursday, June 07, 2012 4:57 PM
To: Baldwin, Melissa Hunting
Cc: Hall, Robert D. (Office of Research)
Subject: RE: PRIME letter PRM-11-037

Do you have any approvals from MURR for their match (regardless of the amount)?

From: Baldwin, Melissa Hunting
Sent: Thursday, June 07, 2012 4:38 PM
To: Breen, Barbara L.
Cc: Hall, Robert D. (Office of Research)
Subject: RE: PRIME letter PRM-11-037

He did not separate out the amounts. He indicated that NSEI and MURR would pay \$75,000 for year 1; \$75,000 for year 2; and \$50,000 for year 3. The total being \$200,000.

Melissa

From: Breen, Barbara L.
Sent: Tuesday, June 05, 2012 4:48 PM
To: Baldwin, Melissa Hunting
Cc: Hall, Robert D. (Office of Research)
Subject: FW: PRIME letter PRM-11-037

Melissa, since MURR is listed as providing part of the match, do you have anything on file where they approved or committed to matching this project? MURR is asking. Thanks.

Barb

From: Baldwin, Melissa Hunting
Sent: Tuesday, March 08, 2011 7:57 PM
To: Loyalka, Sudarshan K.
Cc: Breen, Barbara L.; Schaben, Michelle K.; Prelas, Mark A.; Bennett, James C.
Subject: PRIME letter PRM-11-037

Attached is your PRIME letter.

Melissa Hunting Baldwin
Office of Research
University of Missouri
205 Jesse Hall
Columbia, MO 65211
(573) 882-9500 Fax: (573) 884-8371
melissa@missouri.edu

**University of Missouri
Grant Award Summary**

Responsible OSPA Accountant

NAME Williams, Marvin
PHONE 573-882-9586
FAX 573-884-4078

Original

Report Date : 10-04-2011

Report prepared by: Parachini, Mark J

MoCode: DGF31 Business Unit: COLUM PS Fund: 2100 Dept ID: C1980018 Program: 0 Project: 00034276

| | | | |
|--|------------------------------------|---|--|
| Award Number: 0031040 | Proposal Number: 0031040 | Date Awarded: 09-06-2011 | Sch/Division: Graduate School Department: Nuclear Engineering |
| Award Type: New | | | SubDepartment: |
| Comment : | | | |
| Description: 00118411Loyalka, Sudarshan Kumar | | Agency Name: BATTELLE ENERGY ALLIANCE LLC | |
| Project Title: A Research Program for Pission Product/Dust Transport and Adsorption/deposition in HTGRs | | | |

| | Start Date | End Date | Direct Cost | F&A | Total Cost |
|--------------------|-------------------|-----------------|--------------------|----------------|-------------------|
| This Award: | 09-07-2011 | 09-30-2015 | 793,596.00 | 363,771.00 | 1,157,367.00 |

Budget this Award

| <u>PS Account</u> | <u>Description</u> | <u>Funded Amount</u> | <u>Cost Sharing Amount</u> |
|-------------------|------------------------------|----------------------|----------------------------|
| 700000 | Salaries & Wages | 476,136.00 | |
| 710000 | Staff Benefit | 90,197.00 | |
| 720001 | Department Operating Expense | 140,009.00 | |
| 760001 | Student Aid | 87,254.00 | |
| 981000 | F&A Costs | 363,771.00 | |

| | | Fund | DeptId | Program | |
|--------|------------|-------------|---------------|----------------|------------|
| 700000 | Salary | 0000 | C1980019 | 0 | 63,384.00 |
| 710000 | Benefits | 0000 | C1980019 | 0 | 15,372.00 |
| 770000 | E&E | 0000 | C1980002 | 0 | 200,000.00 |
| 770000 | E&E | 0000 | C4540009 | 0 | 200,000.00 |
| | F&A Offset | | | | 40,559.00 |
| | Waived F&A | | | | 0.00 |

Basis for payment : Cost Reimbursable

| | | | | | | | |
|--------------------------------|---------|-----------------------|---------|------------------------|--------------|-----------------------------|------------|
| Actual | | Applicable | | Total Direct : | 793,596.00 | Cost share Direct : | 478,756.00 |
| F&A Rate : | 51.50 % | F&A Rate : | 51.50 % | Total F&A : | 363,771.00 | Cost share F&A : | 40,559.00 |
| Modified Total Direct : | | | | Total : | 1,157,367.00 | Cost share Total : | 519,315.00 |

For Internal Use Only
 University of Missouri-Columbia
 Nuclear Science & Engineering Institute
 Proposal Title:

Principal Investigator: SK Loyalka
 Agency/Solicitation Number: DOE NEUP / NEUP-001-11
 Period of Support: September 1, 2011- August 31, 2015
 MU Proposal Number: 0031040
 MU Project Number: 00034276

| Item | Dept / Ds | Year One (9/1/11-8/31/12) | | Year Two (9/1/12-8/31/13) | | Year Three (9/1/13-8/31/14) | | Year Four (9/1/14-8/31/15) | | |
|--|-----------|---------------------------|----------|---------------------------|----------|-----------------------------|----------|----------------------------|----------|--|
| | | DOE | MU Match | DOE | MU Match | DOE | MU Match | DOE | MU Match | |
| A. Personnel: | | | | | | | | | | |
| 1. SK Loyalka, PI - (35%) | | 10,455 | 10,455 | 10,455 | 10,455 | 10,455 | 10,455 | 10,455 | 10,455 | |
| 2. TK Ghosh - (15%) | | 16,174 | 5,391 | 16,174 | 5,391 | 16,174 | 5,391 | 16,174 | 5,391 | |
| 3. RV Tompson | | 5,090 | | 5,090 | | 5,090 | | 5,090 | | |
| 4. J Brockman | | 15,000 | | 15,000 | | 15,000 | | 15,000 | | |
| 5. WH Miller | | 3,781 | | 3,781 | | 3,781 | | 3,781 | | |
| 6. JD Robertson | | 3,419 | | 3,419 | | 3,419 | | 3,419 | | |
| 7. D Viswanath | | 6,000 | | 6,000 | | 6,000 | | 6,000 | | |
| 8. Greenleaf | | 8,115 | | 8,115 | | 8,115 | | 8,115 | | |
| 9. Staff Benefits | | 15,502 | 3,843 | 15,502 | 3,843 | 15,502 | 3,843 | 15,502 | 3,843 | |
| 10. GRA (PhD) (2) | | 36,000 | | 36,000 | | 36,000 | | 36,000 | | |
| 11. GRA (MS) (1) | | 15,000 | | 15,000 | | 15,000 | | 15,000 | | |
| 12. In-State Tuition for A.8 (22 crnrs/yr/Fello N/A) | | 20,856 | | 21,482 | | 22,126 | | 22,790 | | |
| 13. Medical Insurance for A.8 | | 6,738 | | 6,940 | | 7,148 | | 7,362.78 | | |
| 14. Undergraduate Students | | | | | | | | | | |
| | | 162,131 | 19,689 | 162,959 | 19,689 | 163,811 | 19,689 | 164,690 | 19,689 | |
| Subtotal A, Personnel: | | | | | | | | | | |
| B. General Operating: | | | | | | | | | | |
| 1. Supplies | | 30,000 | | 30,000 | | 30,000 | | 30,000 | | |
| 2. Travel | | 5,000 | | 5,000 | | 5,000 | | 5,000 | | |
| 3. Publication Charges | | | | | | | | | | |
| 4. Service Charges | | | | | | | | | | |
| | | 35,000 | | 35,000 | | 35,000 | | 35,000 | | |
| Subtotal B, Other Costs of Education: | | | | | | | | | | |
| C. Equipment: | | | | | | | | | | |
| 1. McCode pending on award | | | 100,000 | | 100,000 | | 100,000 | | 100,000 | |
| Subtotal C, Equipment: | | | | | | | | | | |
| D. Subcontracts: | | | | | | | | | | |
| Subtotal D, Subcontracts: | | | | | | | | | | |
| E. Total Direct Costs: | | | | | | | | | | |
| F. Modified Total Direct Costs (TDC - equipment - tuition - subcontract) | | 197,131 | 119,689 | 197,959 | 119,689 | 198,811 | 119,689 | 199,690 | 119,689 | |
| G. Fiscal & Administrative Costs: | | 176,275 | 19,689 | 176,477 | 19,689 | 176,685 | 19,689 | 176,900 | 19,689 | |
| H. Fiscal & Administrative Costs on Subcontract (of first \$25k): | | 90,782 | 10,140 | 90,896 | 10,140 | 90,993 | 10,140 | 91,103 | 10,140 | |
| I. Total Project Costs: | | 287,912 | 129,828 | 289,444 | 129,828 | 289,804 | 129,828 | 290,793 | 129,828 | |

Agency Request: 1,157,353
 MU Matching: 489,484
 Total Project Costs: 1,646,838



Office of Research
University of Missouri-Columbia

205 Jesse Hall
Columbia, MO 65211-1150

PHONE (573) 882-9500
FAX (573) 884-8371

March 8, 2011

Sudarshan Kumar Loyalka
Particulate Research Center
E1425C Engineering Bldg East

Dear Professor Loyalka:

It is my pleasure to confirm a PRIME Fund commitment in the amount of \$200,000 over the course of three years. These funds, along with Department/College cost matches in the amount of \$200,000, are to be directed towards your project titled *A research program for fission product/dust transport and adsorption/deposition in HTGRs*. This PRIME Fund commitment is contingent upon securing \$1,200,000 from the Department of Energy. PRIME funds and things bought with PRIME funds must remain at the University of Missouri-Columbia.

From the materials you submitted, our understanding of the agreement for providing funds for your research needs is:

University and other non-PRIME Matches
NSEI and MURR

PRIME Funds
Year One: \$75,000
Year Two: \$75,000
Year Three: \$50,000

External Agency
Department of Energy

yr. 1 - 25,000
yr. 2 - 25,000
yr 3 - 50,000
year 4 - 100,000

\$200,000
\$200,000
\$1,200,000

Equipment

Best wishes for success in securing external funding for this project.

Sincerely,

Robert Duncan, Ph.D.
Vice Chancellor for Research

mhb

Moore, Marsha M.

From: El-Boher, Arik
Sent: Thursday, June 28, 2012 5:46 PM
To: Duncan, Robert V. (Vice Chancellor of Research); Prelas, Mark A.; Gangopadhyay, Shubhra; Pfeifer, Peter; Burrell, Jacob William; Carter, Karla A.; Friedman, Marianne C.; Smith, Gloria; Hilton, Shelley A.; Licklider, Mary M.
Subject: LOI
Attachments: Letter of Intent- DOE , 6.doc

Hi All,

This is the 6th version. It is still too long, your suggestions are welcome.
Shubhra will put together a paragraph instead all the detailed CV's and another short paragraph describing her facilities.

Arik

US DEPARTMENT OF ENERGY

Energy Innovation Hub- Critical Materials

Addressing

Funding Opportunity Announcement Number: DE-FOA-0000687

Announcement Type: Initial

CFDA Number: 81.086

Letter Of Intent

High Density Hydrogen Storage in Palladium-Carbon Composite Materials

By Sidney Kimmel Institute for Nuclear Renaissance- SKINR

Dr. Arie El-Boher, SKINR Group Leader, elbohera@missouri.edu

University of Missouri, 301 Physics, Columbia MO, 65211-7010

**In collaboration with Dr. Mark Prelas, Dr. Peter Pfeifer and Dr. Shubhra Gangopadhyay
of the University of Missouri**

1. Identification and Significance of the Problem or Opportunity

This Letter of Intent (LOI) is targeting the DOE call for LOI, FOA: DE-FOA-0000687: "Energy Innovation Hub – Critical Materials". This proposal is a collaborative effort between the University of Missouri, the University of Illinois at Champaign Urbana and Purdue University. As stated in this LOI, "government agencies are required to increase alternate fuel consumption at least 10%, reduce greenhouse gas emissions through reduction of energy by 3% annually or 30% by 2015, and reduce fleet petroleum consumption by 2 percent annually through 2015 at a minimum". One way to attain these goals is the use of hydrogen fuel cells instead of gasoline engines. On-board storage of hydrogen in fuel cell vehicles is a challenge. Current methods of storing hydrogen in a gaseous or liquid form cannot achieve the energy density of conventional gasoline per unit volume. In addition, there are issues with logistics, safety and reliability storage that requires high pressure and very low temperatures. The storage of hydrogen on metal hydrides is an alternative approach developed over the past 3-4 decades, but the gravimetric storage densities have reached a plateau of about 3-6 percent by weight. Recent advances with nano-materials have shown enhancements to hydrogen storage with respect to storage density and also related logistics such as pressure and kinetics of hydrogen delivery. The goal of this project is to test the feasibility of increasing the loading density of hydrogen by using nano-material composites."

We plan to test two morphologically different Palladium-C composite nano-materials: (1) composite materials made of Nano diamonds and palladium, and (2) composite materials made of single walled carbon nano tubes (SWCNT) and palladium based on Nano technology developed by Dr. Shubhra Gangopadhyay et al., a LA Pierre Chair professor at the University of Missouri, Columbia, at Electrical & Computers Engineering. Previous experiments by Dr. Prelas et al., a Professor, Director of Research at the University of Missouri, Columbia (MU) [1-6] attained gravimetric hydrogen loading in Nano diamonds of up to 3.6 wt% (at room temperature and atmospheric pressure) when using plasma loading. The relatively high hydrogen loading in Nano diamonds was achieved using novel procedures developed at MU for pre-treating and doping the Nano diamonds with boron. Experiments conducted by Energetics Technologies (who transferred all the knowhow and rights to the University of Missouri- SKINR) and by SKINR showed that palladium coated with SWCNT stored hydrogen at an atomic ratio of H:Palladium = 0.7 to 0.98 and H:C = 1.2, respectively, also at room temperature and atmospheric pressure. This is remarkable because the maximum storage capacity (H:C) of SWCNT alone, without synergistic interaction with Palladium, is less than 0.05 at room temperature (physisorption of H₂ [7]). Palladium alone can store as much as H:Palladium = 1.0. Thus a composite with C:Palladium = H:C = H:Palladium = 1.0 will store as much 5 wt% of hydrogen. SKINR holds the rights for a patent on this novel approach to hydrogen loading that exposes the SWCNT to atomic rather than molecular hydrogen at high pressure [8].

The SKINR institute is located across the University of Missouri campus in locations that are convenient to major research instrumentations that is in shared use by SKINR, such as the MU Nuclear Center, the Cyclotron, SEM facilities and many more. SKINR laboratories of Plasma and Gas Loading facilities located in the Department of Physics and Astronomy and share Professor Peter Pfeifer's advanced Energy storage facilities and instrumentations. SKINR also has laboratories of Electrochemical Loading facilities in the Department of Electrical & Computers Engineering sharing Professor Shubhra Gangopadhyay's state-of-the-art Nano

technology and material analysis Lab. SKINR has direct access to resources and researchers of the university. This provides a unique opportunity to combine expertise and innovations developed independently by SKINR and by leading researchers at MU in a collaborative research and development environment. We believe that combining the approaches of SKINR and of MU will have an additive effect in achieving higher hydrogen loading levels than when the R&D was pursued separately. The role of the palladium in the composite materials is to serve as a hydrogen reservoir and to supply atomic hydrogen to the diamond and SWCNT interfaces with palladium respectively. Palladium is suited to this role due to the high solubility (up to 50 atom %) and high diffusive mobility of hydrogen in palladium even at room temperature. Composite materials will be synthesized in such a way that the carbon-containing nano-particles will be surrounded by palladium. The resulting structure will ensure high stability of the palladium-diamond/SWCNT phase boundary. This is especially important for Palladium-diamond composite materials in which the diamond nano-particles are pre-treated by boron doping and activation of their surface. Boron doping enhances hydrogen diffusion into the diamonds while surface activation enhances hydrogen adsorption on the surface of the Nano diamonds. We therefore expect that hydrogen loading in the composite materials will be higher than in the constituent Nano-particles and palladium on their own.

2. Objectives

The overall objective of the proposed is to assess the feasibility of achieving a higher than 3.6% gravimetric loading of hydrogen in novel materials to address critical material needs in energy storage. Novel types of morphologically distinct C-Palladium composite materials: (1) composite materials made of nano-diamonds and palladium, and (2) composite materials made of SWCNT and palladium.

Specific objectives include the following:

- Establish the feasibility of enhancing the rate of boron diffusion into Nano diamonds and, more importantly, achieving a more uniform boron concentration in the diamonds across the target. By “target” we mean the solid sample to be loaded with hydrogen using a proprietary Highly Modulated Current Waves (HMCW, a compound, nested wave structure used by SKINR with oscillating current waves of variable amplitudes and frequencies, interacting with each other) rather than DC to drive the boron diffusion process, other forms of current waves will also be tested and optimized. Using DC current drive was found, at MU, to result in a very strong boron concentration gradient across the solid target made by pressing Nano diamonds powder [9].
- Develop methods to fabricate solid targets made of Nano diamonds coated by palladium, and similarly for SWCNT. The objective is to minimize the volume fraction (weight %) of the Palladium while achieving the desirable properties of the C-Palladium composite materials.
- Find the combination of B/C ratio and C/Palladium ratio that maximizes the gravimetric hydrogen loading in the composite Nano diamonds – Palladium targets.
- Find the combination of C/Palladium ratio that maximizes the gravimetric hydrogen loading in the composite SWCNT – Palladium targets.

3. Work Plan

There will be two stages in assessing the feasibility to achieve high gravimetric loading: (1) target preparation – preparing targets made of Nano diamonds-palladium and SWCNT-Palladium composites; (2) measuring the hydrogen uptake by the synthesized composite materials.

3.1 Target preparation

Nano diamonds-Palladium targets will be prepared for hydrogen loading experiments. They will vary in the Nano diamond size, in the Nano diamond pre-treatment and in the palladium-to-carbon atom ratio. In addition, at least one dozen targets made of SWCNT - palladium will be prepared for hydrogen loading experiments.

There will be three parts to target preparation: (a) pre-treating the Nano diamonds; (b) preparing a solid target made of Nano diamonds (or SWCNT) and palladium; and (c) characterizing the solid targets.

Dr. Mark Prelas of the University of Missouri-Columbia, Nuclear Science & Engineering Institute, who is a collaborator on this proposal, has previously purchased Nano diamonds in an amount that is more than needed for the proposed Phase I project. These Nano diamonds are of desirable size and purity will be contributed for this project. SKINR will purchase SWCNT from Nano-C Company, Westwood, MA and others, who has been a satisfactory supplier to SKINR in the past.

Pre-treating the Nano diamonds

The primary pre-treatment process to be used for this project is doping the Nano diamonds with boron [9-11]. Dr. Mark Prelas has developed and patented this process. He has extensive experience in pre-treating the Nano diamonds for the purpose of increasing their hydrogen loading capability [1-5].

The presence of boron in the diamond assists the hydrogen loading in the diamond as follows: (1) the dissolution of boron in the diamond lattice (likely, in the interstitial positions) increases the dislocation density in the diamond that results in an acceleration of the hydrogen diffusion into the diamond; and (2) the absorption and, more importantly, adsorption of boron creates additional traps for hydrogen (protons), since the formation of a B-H bond is, energetically, considerably more probable than creation of an C-H bond. It is therefore expected that the adsorption of hydrogen by diamond nanoparticles will be considerably increased due to doping them with boron.

After pre-treatment, the Nano diamonds will be analyzed using the sophisticated equipment in operation at the UM laboratory of Professor Peter Pfeifer of the UM –Columbia, Chairman of the Physics & Astronomy Department – a collaborator in this project, including (a) the Quanta chrome Autosorb-1-C high-precision, automated physisorption and chemisorption instrument for determination of surface areas, pore volumes, pore-size distributions, and catalytically active sites. In addition, hydrogen atoms in the bulk material will be measured by prompt gamma neutron activation analysis (PGNAA) at the University of Missouri Research Reactor (see section 8).

Target characterization

The target characterization will include the following: (a) Quantification of the amount of diamonds per unit volume of target, as well as of the carbon-to-Palladium atom ratio; (b) Quantification of the type and amount of impurities in the target using, among others, SEM-EDS, X-ray AES methods.

University of Illinois

Professor George Miley at the University of Illinois and his colleagues have done extensive work on cluster loading of hydrogen in various hydride forming metals. In addition there is an extensive research effort on chemical energy storage techniques. The University of Illinois has a significant materials research center which offers an extensive diagnostic and characterization facilities.

Purdue University

Professof Yeong Kim and his colleagues at Purdue University have developed extensive modeling capabilities for hydrogen loading in advanced materials. The body of research includes the study of a variety of materials ranging from metal hydrides to nano composite materials.

Polytechnic University of Puerto Rico

Professor Angel Gonzalez and Professor Alejandro Suarez of the Polytechnic University of Puerto Rico and their colleagues will collaborate on this project. Professor Gonzalez is an electrical engineer who is working on the microengineering of materials using high energy implantation. PUPR has a large volume penning trap device which is capable of generating high energy and high density ion beams. The properties of materials are changed by the selective implantation of various elements in the matrix of the material. Dr. Suarez and his group works on the storage of hydrogen in carbon based materials. Polytechnic University of Puerto Rico is the largest predominately Hispanic private university in the United States or its territories.

3.2 Hydrogen loading

The loading of the Nano diamonds-Palladium composite targets will be done with hydrogen plasma using the special facility and method (FEDOA) developed [11] by Dr. Prelas (see Section 8).

The hydrogen loading in the SWCNT-Palladium composite will be carried out in the specially designed high pressure (up to 200bar) stainless steel cell of the HTP-1 facility at the laboratory of Dr. Peter Pfeifer of the University of Missouri, Columbia, Professor of the Physics & Astronomy department . This facility is capable of high accuracy hydrogen uptake measurements at any temperature between 77 K and 500°C (see section 8).

3.3 Measuring hydrogen uptake

The hydrogen uptake measurements will be performed in the hydrogen loading laboratory of Dr. Peter Pfeifer. The primary equipment to be used is a state-of-the-art, high-pressure hydrogen adsorption instrument, HTP1, which is a workhorse for hydrogen sorption measurements. The

equipment enables to measure the hydrogen uptake by thermal desorption and online mass spectrometer. See Section 8 for more information on the HTP1.

Other methods that will be available in UM to this project for measuring hydrogen uptake include (a) Prompt gamma neutron activation analysis (PGNAA), (b) Secondary Ion Mass Spectroscopy (SIMS), (c) Fourier Transform Infra-Red Spectroscopy (FTIR), and (d) high-sensitivity micro-balances. For details see Section 8. All these methods have been successfully used before for measuring hydrogen loading by Dr. Prelas et al.

3.4 Work plan

Phase I will establish the feasibility to produce a new C-Palladium composite material that has capability for high gravimetric hydrogen loading. Such a material could be the basis for a system with favorable logistics characteristics such as pressure and kinetics of hydrogen delivery. Phase I duration is planned for 1 year.

Phase II effort will focus on the optimization of the composite material composition and fabrication process, and on the demonstration of this optimal material for commercial application (such as for hydrogen supply for fuel cells). Phase II research and development would include assessment of scalability of the process and development of pre-commercial prototype systems with a view to deployment in pre-commercial demonstration applications. Phase II duration is planned for 2.5 years.

Phase III will focus on the development of processes and procedures for manufacture of a commercial product. Phase III duration is planned for 1.5 years.

All this work will be done in facilities and will use equipment that is available at either SKINR or the University of Missouri (see section 8).

4. Related Work

SKINR have conducted work related to this proposal dealing with hydrogen loading in a variety of materials in continuation to Energetics work on hydrogen loading [12-14]. The unique loading technique developed and used by SKINR is described in Section 3.1.a. Using its unique technique based on highly modulated current drive (see sec. 3.1.a), SKINR achieved very high hydrogen loading. An independent replication of the hydrogen/deuterium loading performed at SRI International of Menlo Park, CA and at US Naval Research Lab. (NRL), that was sponsored by DARPA [15] concluded that: "The extreme level of loading and high consistency of good loading are attributable to two features of this set of experiments: i. A high degree of micro structural metallurgical control allows electrodes to accept loading without damaging deformation. This treatment process has been developed largely at ENEA (with which SKINR is collaborating, also for this project) and involves not only control of the bulk crystalline but extends to control of the surface roughness. SKINR will collaborate in this project with SRI headed by Dr. Michael McKubre and NRL headed by Dr. Graham Hubler. Both laboratories have vast experience and knowledge in hydrogen loading.

ii. Highly Modulated excitation function produces current driven fields which interact with the hydrogen atom-ion dynamics in a number of ways. Regions of interest are: the mass transport controlled boundary layer in the electrolyte, the charged electrochemical double layer and the

associated electrochemical kinetic process at the electrode/electrolyte interface, the dynamic diffusion region of absorbing deuterium atoms just below the cathode surface. The role or roles of Highly Modulated Waves in affecting these processes justifies further study as a potential for a new and better means to load hydrogen into diamond – metals composites.”

SKINR experimented with materials that included composite targets made of single walled carbon nano tubes (SWCNT) coated inside and out with palladium and deposited on palladium substrate. The hydrogen loading achieved in the SWCNT has hydrogen to carbon ratio 1.2 hydrogen [8]. Figure 1 left shows the outer surface of the sample after the palladium coating deposition. Figure 2 rights shows the SWCNT layer on top of the palladium substrate

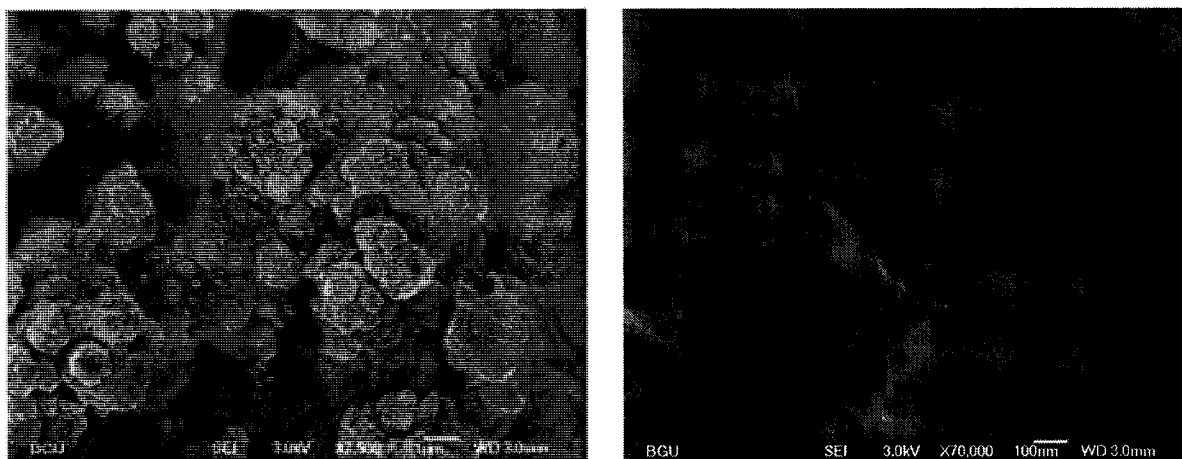


Figure 1-2. A view of the outer surface of the Palladium outer coating (left) and of the SWCNT layer below this coating (right).

SKINR facilities which are located across the University of Missouri campus at Columbia, MO, will perform the proposed project in close collaboration with University of Missouri researchers and their research teams – Professor Mark Prelas and Dr. Peter Pfeifer and Professor Shubhra Gangopadhyay. Professor Prelas is an expert in preparation of, and hydrogen loading into diamonds [1-6; 8-10]. Professor Pfeifer is an expert in high pressure hydrogen loading in powders and porous materials. He is the leader of the Alliance for Collaborative Research in Alternative Fuel Technology (ALL-CRAFT) – a partnership of the University of Missouri-Columbia (UM, lead institution), the Midwest Research Institute in Kansas City, and other partners to develop low-pressure, high-capacity storage technologies for natural gas (NG, methane) and hydrogen as alternative fuels for advanced transportation. Professor Gangopadhyay is an expert in Nano technologies and in particular in SWCNT

Intellectual Property: SKINR holds rights to patent pending IP in the field of this proposed project, as does the University of Missouri. Follow-on inventions by SKINR will be patented by, and assigned to SKINR. Rights to patents arising from joint work with the University of Missouri will be allocated on the basis of a pre-agreed formula.

7. SKINR Key Personnel

SKINR senior researchers are Israeli nationals admitted to the US with H-1B visas and authorized for employment in the US. The principal investigator for this project is Dr. Arie El-Boher, who has worked at Energetics since it was founded and continued to work for SKINR as a group leader. Dr. El-Boher will be responsible for the experiments to be conducted in SKINR Labs as well as to the management of the project and to the coordination between the university groups and SKINR. Dr. Tsirlin a senior scientist in SKINR is responsible for the material science related R&D work for the variety of materials investigated for hydrogen loading. He has very broad experience in material science, physical chemistry, composite and semiconductor materials, high-temperature corrosion and protection, CVD and PVD coatings and films. Dr. Tsirlin is also experienced with the application of modern experimental methods for analysis of surfaces and interfaces, thermodynamics and kinetics of high-temperature processes (SEM-EDS, TEM, X-ray, XPS-AES, SIMS, Differential Thermal Analysis, Differential Gravimetric Analysis, etc.).

Arie El-Boher

Dr. El-Boher has worked at Energetics since the foundation of the company and continued to work for SKINR. He was responsible for R&D programs. He has experience with Glow Discharge hydrogen plasma) cells. In addition, he is experienced in the preparation of Palladium (Palladium) foils coated by micron thick single or multi layers of Palladium and other metals, using a radio frequency generated Argon plasma cell in order to increase the hydrogen loading.

Dr. El-Boher has a PhD degree in Mechanical Engineering from the Ben Gurion University, Israel, and has more than 20 years of experience in experimental heat and mass transfer research and development, in thermodynamics and fluid mechanics. Dr. El-Boher is the author of over 70 papers and inventor of 8 patents, issued and pending. He holds Israeli citizenship and a US H-1B work visa.

Mark Tsirlin

EDUCATION:

Institute of Physical Chemistry USSR Ac. Sc., Moscow. **Dr. Sc.** Physical Chemistry: 1985.

Moscow State University: **Ph.D.** Inorganic Chemistry 1968.

Institute of the Fine Chemical Technology: Moscow: **M. Sc.** Chemical Engineering: 1956-1962.

EMPLOYMENT HISTORY:

2012- Present Senior Researcher in SKINR with same duties as at Energetics Technologies USA.

2010-2011 Energetics Technologies USA, Ltd. Senior Researcher. Studies of the processes of phase, structural and composition transformations, which accompany absorption of Deuterium and Hydrogen by Palladium and composite materials.

2000-2004 CeLight Israel, Ltd. Senior Researcher

1992-2000. Solmecs Israel, Ltd. Beer Sheva

1968-1992 Institute of Physical Chemistry Ac. Sc., Moscow,

Research, Development and Implementation of Composite Materials for High-Temperature Application.

SELECTED PUBLICATIONS:

- Book "High-Temperature Corrosion and Protection of Ultra-Refractory Metals" (published in USSR and in Japan in 1977,
- Dardik, T. Zilov, H. Branover, A. El-Boher, E. Greenspan, B. Khachaturov, V. Krakov, S. Lesin and M. Tsirlin, "Progress in electrolysis experiments at Energetics Technologies," in Proc. of the 12th International Conference on Condensed Matter Nuclear Science (ICCF-12), Yokohama, Japan, 2005
- M.S.Tsirlin, S.Yu.Rybakov, and A.D.Shutikov, Phase Formation at Diffusion Saturation of Niobium by Boron, Zirconium and Silicon, Proc. of USSR Ac.Sci. ser. Metals (Rus.) (1989), #6, 186.
- M.S.Tsirlin, A.V.Kasatkin, G.M.Plavnik, and V.N.Vechkanov, Influence of **Palladium** on Formation and Protective Properties of Molybdenum – Silicon Coatings on Niobium, Powder Metallurgy (Rus.), (1982), #1, 26.
- M.S.Tsirlin, V.M.Khotin, B.F.Gulev, and A.I.Krasovski, Study of Boronized Thoriated Tungsten, Proc. of USSR Ac.Sci. Ser. Inorganic Materials (Rus.), (1979), #1, 64.

Mark A. Prelas

EDUCATION AND TRAINING

- B.S. Eng. Sci., Colorado State University, 1975
- M.S. Nucl. Eng., University of Illinois at Urbana-Champaign, 1976
- Ph.D. Nucl. Eng., University of Illinois at Urbana-Champaign, 1979

RESEARCH AND PROFESSIONAL EXPERIENCE

- Director of Research, Nuclear Science and Engineering Inst. 2003-present
- H.O. Croft Professor, July 1990 to 2002.
- Assistant Director, Particulate Systems Research Center, May 1996 to present.
- Visiting Professor, School of Physics, University of New South Wales, Australia, August 1992 to January 1993.
- Lloyd and Margaret Ketcham Research Professor, July 1988 to July 1990.
- Professor of Nuclear Engineering; May 1989 to July 1990.
- Dr. Prelas' research interests are in the areas of direct energy conversion, energy storage, wide band-gap materials, plasmas, plasma engineering and nanophase materials. Dr. Prelas has directed two NATO Advanced Research Workshops in the Former Soviet Union including the first such meeting in the Former Soviet Union, served as a project advisor for the International Science and Technology Center (in the area of direct energy conversion), directed a grant from the White House to assist non-weapon scientists from the Former Soviet Union, served on a NATO High Technology Review Committee, edited several books and has 9 US and international patents. Selected as Foster Fellow of the Arms Control and Disarmament Agency 1999; Elected as Fellow of the American Nuclear Society, 1998; Fulbright Fellow, University of New South Wales, Australia August 1992 to January 1993; Presidential Young Investigators Award, 1984; Gas Research Institute Workshop Fellow on Synthetic Fuels Production from Inorganic

Resources, 1981. He has authored over 200 papers, has published 10 books and holds 16 patents.

SELECTED PUBLICATIONS

- Handbook on Industrial Diamond and Diamond Films, Prelas, M.A., Popovici, G., Bigelow, L.K., (Editors), Marcell-Dekker, ISBN 0-8247-9994-1 (1998).
- Wide Band-Gap Electronic Materials, Prelas, M.A., Gielisse, P.J., Popovici, G., Spitsyn, B.V., and Stacy, T., (Editors), Kluwer, ISBN 0-7923-3405-1 (1995).
- Diamond Based Composites and Related Materials, Prelas, M.A., Benedictus, A., Lin, Li-Te S., Popovici, G., and Gielisse, P., (Editors), Kluwer, ISBN 0-7923-4667-X (1997).
- Science and Technology of Terrorism & Counter-Terrorism, Ghosh, T.K., Prelas, M.A., Viswanath, D.S., and Loyalka, S.K., Editors, Marcel Dekker (2002).
- Mark A Prelas and *Saha Krishnendu*, Wide Band-Gap Electronic Materials, Encyclopedia of Chemical Processing, Ed. S. Lee, Marcel Dekker (2005).
- Angel Velez and Mark A. Prelas, Diamond Film Applications, Encyclopedia of Chemical Processing, Ed. S. Lee, Marcel Dekker (2005).
- Angel Velez and Mark A. Prelas, Diamond-Like Film Applications, Encyclopedia of Chemical Processing, Ed. S. Lee, Marcel Dekker (2005).
- Prelas, Mark A.. Direct conversion of nuclear energy to electricity. *Al'ternativnaya Energetika i Ekologiya* (2007), (4), 48-56.
- Meyer, R. M.; Smith, Z. M.; Prelas, M. A.; Loyalka, S. K. Ion flow convergence in spherical inertial electrostatic confinement devices. *Physics of Plasmas* (2008), 15(2), 022105/1-022105/13.

Peter Pfeifer

PROFESSIONAL PREPARATION

Swiss Federal Institute of Technology (ETH), Zurich; Chemistry, B.S., 1969.
 Swiss Federal Institute of Technology (ETH), Zurich; Physics, Ph.D., 1980.
 Hebrew University of Jerusalem; Molecular Physics and Statistical Mechanics, 1981-82.
 University of Bielefeld, Germany; Habilitation, Department of Chemistry, 1986.

APPOINTMENTS

Chair-Elect (2007) & Chair (2008-present), Department of Physics, University of Missouri, Columbia.
 Visiting Fellow, Research Program "Nature-Inspired Energy Efficient Process Design," Center of Advanced Studies, Norwegian Academy of Sciences, Oslo, 2008.
 Visiting Professor, Laboratory for Physical Chemistry and Molecular Thermodynamics, Delft University of Technology, Netherlands, 2004, 2005.
 Affiliate, Los Alamos National Laboratory, 2002-present.
 Visiting Scientist, Center for Nonlinear Studies, Los Alamos National Laboratory, 2000-01.
 Senior Associate, Institute for Physical Sciences, Inc., Los Alamos & McLean, 1997-present.
 Professor of Physics, University of Missouri, Columbia, 1995-present.
 Visiting Scientist, Laboratory of Condensed Matter Physics, Ecole Polytechnique, Paris, 1994.
 Visiting Professor, Institute of Theoretical Physics, ETH, Zurich, 1993-1994.
 Associate Professor of Physics, University of Missouri, Columbia, 1986-1995.

Assistant Professor of Chemistry, University of Bielefeld, Germany, 1982-1986.

Research Fellow, Fritz Haber Research Center for Molecular Dynamics, Hebrew University of Jerusalem, 1981-82.

Research Associate and Instructor, Department of Chemistry, ETH, Zurich, 1975-1980.

SELECTED PUBLICATIONS

B. Kuchta, L. Firlej, P. Pfeifer, and C. Wexler, "Numerical Estimation of Hydrogen Storage Limits in Carbon-Based Nanospaces." *Carbon* 48, 223-231 (2010).

B. Kuchta, L. Firlej, S. Roszak, P. Pfeifer, and C. Wexler, "Influence of Structural Heterogeneity of Nanoporous Sorbent Walls on Hydrogen Storage." *Appl. Surf. Sci.*, 256, 5270-5274 (2010).

J. Burress, M. Kraus, M. Beckner, R. Cepel, G. Suppes, C. Wexler, and P. Pfeifer, "Hydrogen storage in engineered carbon nanospaces." *Nanotechnology* 20, 204026 (2009).

P. Pfeifer, G.J. Suppes, and 16 additional authors, "High-surface-area biocarbons for reversible on-board storage of natural gas and hydrogen." *Mater. Res. Soc. Symp. Proc.* 1041E, 1041-R02-02-(1-12) (2008).

P. Pfeifer, F. Ehrburger-Dolle, T.P. Rieker, M.T. González, W.P. Hoffman, M. Molina-Sabio, F. Rodríguez-Reinoso, P.W. Schmidt, and D.J. Voss, "Nearly space-filling fractal networks of carbon nanopores." *Phys. Rev. Lett.* 88, 115502-(1-4) (2002).

D. Avnir, D. Farin, and P. Pfeifer, "Molecular fractal surfaces." *Nature* 308, 261-263 (1984).

SYNERGISTIC ACTIVITIES

Principal Project Leader of the "Alliance for Collaborative Research in Alternative Fuel Technology (ALL-CRAFT, a partnership of the University of Missouri and Midwest Research Institute, Kansas City, with over 40 undergraduate research interns, 15 graduate students, and 20 senior scientists, funded by NSF's Program "Partnerships for Innovation" (2004-07), DOE (2007-13), DOD (2007-11), and California Energy Commission (2009-12) to develop novel storage materials for natural gas and hydrogen for advanced next-generation clean vehicles (2004-present). Featured in *NSF Press Release 07-011 (2/16/07)*, *BusinessWeek*, 3/12/07, and over 100 national and international press reports.

WE NEED HERE SHUBHRA'S CV

8. Facilities/Equipment

SKINR occupies 2,500 square feet Labs in the Life Science Business Incubator at the University of Missouri. The incubator is operated by a non-profit business assistance organization, -- the Missouri Innovation Center, that specializes in research, development and commercialization of technology. The tasks in the proposal will be carried out mainly at SKINR and also at the university facilities of our research collaborators, Dr. Mark Prelas and Dr. Peter Pfeifer and Dr. Shubhra Gangopadhyay.

SKINR laboratories include:

- Laboratory for chemical treatment and analysis of targets
- Laboratory for mechanical and thermal treatment of targets
- Cells for conducting electro-phoresis of SWCNT on Palladium substrates
- RF plasma cell for coating with palladium (or other materials)

- Cells for hydrogen gas loading
- Cells for hydrogen loading using electrolysis

The Field Enhanced Diffusion with Optical Activation (FEDOA) apparatus developed and patented by Dr. Prelas et al. [10] will be used for doping boron and for hydrogen loading of Nano diamonds and SWCNT. It uses an optically and thermally enhanced forced diffusion by applying, respectively, an external electric field and lasers.

The Hiden HTP1 volumetric hydrogen adsorption/desorption instrument in Dr. Pfeifer's lab is specifically designed for high accuracy hydrogen sorption measurements on a range of potential hydrogen storage materials over a wide range of temperatures (77-773 K) and hydrogen pressures (0-200 bar). The instrument offers fully automated operation for the measurement of metal hydride pressure-composition isotherms (PCIs) and excess adsorption isotherms for micro porous adsorbents. The Hiden HTP1 high-pressure hydrogen adsorption instrument is widely considered the best commercial hydrogen sorption analyzer in the market. The instrument delivered to the University of Missouri in November 2008 was the first of its kind in the US. It integrates one of a range of top-loading micro reactor beds with computer control of pressure, gas flow, and temperature. A glove box housing the microreactor allows for sample handling (filling/removal of samples into/from the sample cell) under an inert gas atmosphere (Ar).

Additional equipment in Dr. Pfeifer's laboratory that will be available for this project is a Quanta chrome Autosorb-1-C high-precision, automated physisorption and chemisorption instrument for determination of surface areas, pore volumes, pore-size distributions, and catalytically active sites.

Shubhra we need here your facilities description- short..

Additional possible diagnostics of hydrogen loading the University of Missouri will make available and that may be used for this project include the following:

Prompt Gamma Neutron Activation Analysis (PGNAA): The University of Missouri Research Reactor Center (MURR) is the highest-flux university-operated research reactor in the world (10 MW). By exposing the loaded target to thermal neutrons, neutrons captured in the H nuclei emit, instantaneously, 2.22 MeV gamma ray. By measuring the intensity of these prompt gamma rays it is possible to accurately deduce the amount of hydrogen loaded into the target. PGNAA at the MURR is capable of measuring quantities of hydrogen as small as the parts per billion level; it had been used successfully for hydrogen loading quantification [2].

Secondary Ion Mass Spectroscopy (SIMS): An ion beam impinging on the target sputters off small amount of near-surface material. The sputtered material is then analyzed downstream by a mass spectrometer. This technique gives direct information on the composition of a target as a function of depth (i.e. sputtering time is proportional to depth). This method is only able to measure the density of atoms in the first few microns of the target.

Fourier Transform Infra-Red Spectroscopy (FTIR): This spectroscopic technique uses infrared absorption to quantify the composition of a sample based on the characteristic absorption lines of the individual constituents. The absorption is proportional to the absorbing state density. For hydrogen, one looks for the characteristic C-H stretch. This method can measure hydrogen which is bonded to carbon in the bulk sample. It is unable to detect unbounded hydrogen.

9. Collaborators

The subcontractor will be the University of Missouri at Columbia; specifically Professor Mark Prelas, director of research at the Nuclear Science and Engineering Institute, and Professor Peter Pfeifer, Chairman of the Physics Department and Professor Shubhra Gangopadhyay, La Pierre Chair Professor, Electrical and Computers Engineering.

References

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2. M.A. Prelas, T K. Ghosh, R. V. Tompson, S.K. Loyalka, "Hydrogen Storage in Diamond Films", ANS Transactions, 87, 363-364, 2002.
3. L. Velez, M. A. Prelas, T. K. Ghosh, "Hydrogen Storage in Pressed Nanophase Diamond Powder", ANS Transactions, 91, 109, 2004.
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6. M.A. Prelas, G. Popovici and L.K. Bigelow, Editors, "Handbook on Industrial Diamond and Diamond Films," Marcel-Dekker, 1998, ISBN 0-8247-9994-1.
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8. A. Lipson, B. F. Lyakhov, T. Zilov and E. Greenspan, "Systems and Methods for Hydrogen Loading and Generation of Thermal Response," Pending US Patent Application, submitted 2006. Rights assigned to Energetics Technologies.
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12. I. Dardik, T. Zilov, H. Branover, A. El-Boher, E. Greenspan, B. Khachaturov, V. Krakov, S. Lesin and M. Tsirlin, "Excess Heat in Electrolysis Experiments at Energetics Technologies," in Proc. of the 11th International Conference on Cold Fusion (ICCF-11), Marseilles, France, November 1 - 6, 2004.
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14. I. Dardik, T. Zilov, H. Branover, A. El-Boher, E. Greenspan, B. Khachaturov, V. Krakov, S. Lesin, A. Shapiro and M. Tsirlin, "Ultrasonically-excited electrolysis Experiments at Energetics Technologies," in Proc. of the 14th International Conference on Condensed Matter Nuclear Science (ICCF-14), Washington, DC, August 10-15, 2008.

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16. M. C. H. McKubre et al., "New Physical Effects in Metal Deutrides," Final Report to DAEPA for Contract No. HR0011-05-C-0089; SRI Project No. P16816, 2007.

Moore, Marsha M.

From: Dean, Kenneth D.
Sent: Thursday, June 28, 2012 9:48 PM
To: Justice, George
Subject: RE: NSEI

Need to keep Brian totally in the loop.
Ken

From: Justice, George
Sent: Thursday, June 28, 2012 4:51 PM
To: Dean, Kenneth D.
Subject: FW: NSEI

And more. Should we talk to Brian about this now? Or let it develop as it's going?

From: <Churchill>, Robert <ChurchillR@health.missouri.edu>
Date: Thursday, June 28, 2012 4:16 PM
To: George Justice <justiceg@missouri.edu>
Subject: RE: NSEI

OK. Rich and I are working on this. we had a good meeting with the NSEI folks last week.

Robert J. Churchill, MD
Hugh E. and Sarah D. Stephenson Dean
Lodwick Distinguished Professor of Radiology
School of Medicine
University of Missouri
One Hospital Drive - DC018.00
Columbia, MO 65212
(573) 884-9080
(573) 884-4808 fax
churchillr@health.missouri.edu

From: Justice, George
Sent: Thursday, June 28, 2012 3:42 PM
To: Churchill, Robert
Subject: Re: NSEI

Long term I think both "Nuclear Engineering" and "Medical Physics" are going to be in flux--and I think that most new faculty would be interested in space down at the reactor. So let's not let this get in the way!

George

On Jun 28, 2012, at 2:48 PM, Churchill, Robert wrote:

100%. Only concern is research space. Short term I think we are OK. Long term is the question.

From: Justice, George
Sent: Thursday, June 28, 2012 12:57 PM
To: Churchill, Robert
Subject: Re: NSEI

Bob,

The university certainly could not guarantee that. The space would revert back to the control of the College of Engineering after any NSEI faculty members retired. The dean of Engineering might or might not allocate that space to a new Nuclear Engineering faculty member. As always we would work with units on securing appropriate office and laboratory space to faculty--the reactor might be one place (among others) that new faculty with specialities in Nuclear Engineering might find laboratory space.

So--what are the odds of pulling this off?

Thanks for all your work,
George

--
George Justice
Dean of the Graduate School
Vice Provost for Advanced Studies
210 Jesse Hall
University of Missouri
Columbia, MO 65211
573-884-1402
JusticeG@missouri.edu

On Jun 26, 2012, at 10:14 AM, Churchill, Robert wrote:

I did not mean the retiree would keep space, but would their replacement keep the space (same space with new person)?

From: Justice, George
Sent: Tuesday, June 26, 2012 9:06 AM
To: Churchill, Robert
Subject: Re: NSEI

Yes, the faculty lines would stay in Radiology. I can't promise the same for the research space. Retirees do not, as a matter of course, retain offices, let alone laboratory space. (That goes with the NSEI faculty members'

current appointments, too.) Let me know if I can help further, and thanks for trying to figure out how to help this situation....

Best,
George

--

George Justice
Dean of the Graduate School
Vice Provost for Advanced Studies
210 Jesse Hall
University of Missouri
Columbia, MO 65211
573-884-1402
JusticeG@missouri.edu

On Jun 26, 2012, at 8:33 AM, Churchill, Robert wrote:

A couple of questions. Will all the salary lines remain in radiology even after these guys retire? Do they maintain their current research space even after they start to retire?

Moore, Marsha M.

From: Justice, George
Sent: Friday, June 29, 2012 6:35 AM
To: Foster, Brian L. (Provost)
Cc: Dean, Kenneth D.
Subject: Re: NSEI

Okay--don't think much will happen today! But I'll call if anything comes up.

George

On Jun 29, 2012, at 6:12 AM, "Foster, Brian L. (Provost)" <fosterbl@missouri.edu> wrote:

> That is really good news. We can talk Mobday...but if we need to talk before then call me on my cell phone.

> Brian

>

> Sent from my iPhone

>

> On Jun 29, 2012, at 6:34 AM, "Justice, George" <justiceg@missouri.edu> wrote:

>

>>

>>

>> Brian,

>>

>> Rich Oliver and Bob Churchill had a discussion last week (or earlier this week--not sure of the exact timing) with the NSEI faculty. Yesterday Bob told me there's a 100% chance that the NSEI faculty will move to Radiology. They are also talking about SHP and Medicine jointly administering health physics and medical physics. I don't know exactly what that would look like, but I do believe that those emphasis areas would be best administered in SHP, which is the unit on campus that understands clinical graduate degrees.

>>

>> I myself have been talking with Bill Logan over in radiation oncology at Ellis Fischel and I am going over to meet with him and his colleague Bill Kennedy on July 12.

>>

>> Bob was asking questions earlier this week about space. The tenor of the questions suggests to me that Sudarshan is working out a deal in which he might go over to radiology (they all would) and then Sudarshan would retire, opening up for new hires. Bob wanted to know if new faculty would be guaranteed space in Lafferre. In consultation with Ken I said no--that once current NSEI faculty retire that space would fall under the control of engineering. But that we would help find space for new nuclear research faculty outside of the college of Engineering, perhaps down at the reactor or elsewhere.

>>

>> I'd be happy to brief you about this. Because the questions focused on space, I've been in touch with Ken, who can add anything I've missed (I'm copying him here).

>>

>> George

Moore, Marsha M.

From: Hall, Robert D. (Office of Research)
Sent: Friday, June 29, 2012 7:54 PM
To: Attebery, Jeffrey R.
Cc: Butler, Ralph; Breen, Barbara L.
Subject: Re: NSEI research project at MURR.

Jeff, I will follow up. It will be about a week before I am back. Can it wait that long?

Robert D. Hall, Ph.D., J.D.
Associate Vice Chancellor
Office of Research
205 Jesse Hall
University of Missouri
Columbia, Missouri 65211
(573) 882-9500

If you are not the intended recipient of this message, I request that you destroy it.

On Jun 28, 2012, at 16:33, "Attebery, Jeffrey R." <AtteberyJ@missouri.edu> wrote:

> Dr. Hall,

>

> Per recent discussions at MURR, we would like to accept your offer to inquire with Dr. Loyalka about the availability of funds to retrofit a beam line at MURR. That being said, here is a short synopsis per your request when I met with you and Barb Breen a few weeks ago.

>

>

> Dr. John Brockman (MURR researcher) recently initiated a work order for MURR staff to retrofit a reactor beam line. He estimates the total cost for this work to be ~\$200K. When I asked Dr. Brockman about the funding for this work, he replied that this retrofit was necessary for the research project being funded with the DOE NEUP grant (project 00034276) and he presumed that this grant would fund the retrofit. Since this grant is a NSEI administered grant, I contacted James Bennett. James replied that this grant has no budget to fund the beam line work at MURR. I obtained the attached Grant Award Summary and after a close review of the grant budget, I concur with James. However, I noticed on the attached GAS that there is \$200K in PRIME and \$200K in department cost match associated with this research project too. Thinking that one of these might be the source of funds "earmarked" to pay for the beam port retrofit, I followed up on them. What I found and confirmed with Barb Breen is that \$75K of the \$200K PRIME commitment has been transferred from the Office of Research to NSEI, and this \$200K PRIME commitment is being solely used to fund lab equipment at MURR. More specifically, Dr. Brockman, with approval from Dr. Loyalka, has already spent ~\$175K of the PRIME commitment to purchase a new ICPMS - which was recently installed at MURR. Dr. Brockman also has plans (with Loyalka approval) to procure another piece of lab equipment worth ~\$20K to be funded with PRIME. As for the \$200K department cost match, it seems that Dr. Loyalka earlier suggested these funds would come from NSEI and MURR RIF dollars applicable to the DOE NEUP grant. Unfortunately, there seems to be two concerns with this. One, I cannot find any documentation where MURR formally agreed to contribute MURR RIF or any other MURR funding toward the \$200K cost match commitment. And two, even if the RIF from all investigators was to be allocated toward the department cost match, the RIF total calculates to ~\$90K - well short of the \$200K match.

>

> Since there seems to be some uncertainty regarding the availability of funds to pay for MURR's beam line retrofit, MURR has placed Dr. Brockman's work order on hold.

>

> As you will see, I have attached some pertinent documents related to the synopsis. Should you need other documentation or have any questions, please let me know.

>

> Thank you for your offer to inquire with Dr. Loyalka.

>

> Jeff

>

> Jeff Attebery

> Asst. Director, MURR Fiscal Services

> (573) 882-5269

> atteberyj@missouri.edu<<mailto:atteberyj@missouri.edu>>

>

>

>

> From: Hall, Robert D. (Office of Research)

> Sent: Tuesday, June 12, 2012 8:47 AM

> To: Attebery, Jeffrey R.

> Subject: RE: NSEI research project at MURR.

>

> Jeff:

>

> That sounds fine. Ralph and Dave should be in agreement before we approach NSEI.

>

> - Rob

>

> *****

> Robert D. Hall, Ph.D., J.D.

> Associate Vice Chancellor for Research and Director of Compliance

> Office of Research University of Missouri

> 205 Jesse Hall

> Columbia, Missouri 65211

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>

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>

> From: Attebery, Jeffrey R.

> Sent: Tuesday, June 12, 2012 08:20

> To: Hall, Robert D. (Office of Research)

> Cc: Breen, Barbara L.

> Subject: NSEI research project at MURR.

>

> Dr. Hall,

>

> Thank you for your insight last Friday afternoon regarding the NSEI/Dr. Loyalka/Dr. Brockman research project which will utilize facilities at MURR. As you will recall, I approached Barb last week with some reservation about the DOE/NEUP grant, PRIME and PRIME match funding for this project – all of which are administered by NSEI. More specifically, I'm concerned as I can't seem to obtain clarification about which funds will cover MURR's cost of ~\$200K to retrofit a beam port.

>

> Instead of sending you a short synopsis as a basis for you to inquire with Dr. Loyalka, would you mind if I waited on that until after I've had a chance to review all of this with Ralph Butler and Dr. Dave Robertson? I've only briefly apprised Ralph and Dave and would like to fully apprise them prior to any communication with Dr. Loyalka.

>

> Thanks,

> Jeff

>

> Jeff Attebery

> Asst. Director, MURR Fiscal Services

> 882-5269

> atteberyj@missouri.edu<mailto:atteberyj@missouri.edu>

>

>

> <RE: PRIME letter PRM-11-037.eml>

> <usgm1554_4389964.pdf>

> <00034276- Int Budget & Match.pdf>

> <Loyalka PRIME 11-037.pdf>