NASA GRANTS - NAG3-2750 & NAG3-2930

IMPACT

(Publications, Invention Disclosures, Graduate Students)

Dr. Tim Anderson
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July, 2008
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Executive Summary
The University of Florida has developed a very strong hydrogen-technology base with four consecutive NASA grants totaling $10M funding during the period of March 2002 and ending March 2008. The grant was managed by NASA Glenn Research center.

The NASA Hydrogen Research program at UF covered hydrogen technologies related to fuel cells, hydrogen production processes, cryogenic transport and storage, distributed sensors and laser instrumentation for hydrogen leak detection, and outreach. The fuel cell research was added during the last two grant periods. The fuel cell research included cross-cutting technologies for proton exchange membranes (PEM) and solid oxide fuel cells (SOFC).

Dr. Tim Anderson, Associate Dean of Research, was the Primary Investigator (PI) for the grant. The management structure of the program included 3 faculty coordinators and a program manager, as summarized in the program web site: http://www.mae.ufl.edu/NasaHydrogenResearch/index.php?src=Faculty&IDS=88|89|85.

The research thrust areas and the faculty coordinators for the 4th grant were:
- Hydrogen Production, Storage, and Transport, Dr. Jim Klausner, Mechanical and Aerospace Engineering
- Sensors for Hydrogen Leak Detection, Dr. Jenshan Lin, Electrical and Computer Engineering
- Fuel Cells, Dr. Mark Orazem, Chemical Engineering

There were 40 task PI’s, 4 post-docs, 99 graduate, and 12 undergraduate students under the grant. Some of the task PI’s had more than one task. To date, researchers involved in this program have filed 6 patents/invention disclosures in all hydrogen technology areas and published more than 300 technical publications and made over 200 presentations acknowledging NASA support. The task PI’s have submitted proposals totaling more than $70M to external funding agencies. The total new funding received to date is $9.98M.

The outreach activities included the development of a web site and a graduate course in hydrogen technology, as illustrated at the following web site: (http://www.mae.ufl.edu/NasaHydrogenResearch/index.php?src=h2webcourse). In addition, two graduate students participated in summer internship at Glenn Research Center and one student at Kennedy Space Center.

The $10M NASA hydrogen grant became an accelerator to establish an energy institute at UF. The Florida Institute for Sustainable Energy (FISE) became official on January 22, 2007 (http://www.energy.ufl.edu/). Dr. Eric Wachsman, FISE Director and also one of the Task PI’s, received a $4.5M Florida Center of Excellence award and established the Energy Technology Incubator for FISE to facilitate the commercialization of energy technologies.

Finally, it is noted that the State of Florida just announced the establishment of the Florida Energy Systems Consortium by statute. Funding in the amount of $50M was provided by the State and included many of the participants in the NASA program.
The impact of the NASA grant is measured by:

- Number of Students
- Number of Publications
- Number of Invention Disclosures and Patent Applications
- Number of Collaborations
- Funding Received by Leveraging NASA Grant
- Dollar Amount of the Proposals Written

The list of students, publications, invention disclosures, patent application and collaborations are given in the report for each faculty member. The summary of this information is given in the table below:

### The Impact of all 4 NASA Grants

<table>
<thead>
<tr>
<th>Attributes</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Post Docs</td>
<td>4</td>
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<tr>
<td>Number of PhD Students</td>
<td>61</td>
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<tr>
<td>Number of MS Students</td>
<td>39</td>
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<td>Number of Undergraduate Students</td>
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<tr>
<td>Number of High School Students</td>
<td>1</td>
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<tr>
<td>Number of Students Graduated</td>
<td>108</td>
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<tr>
<td>Students Interns Sent to GRC/KSC</td>
<td>3</td>
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<tr>
<td>Number of Publications (Journals/Books)</td>
<td>180</td>
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<tr>
<td>Number of Conference Papers</td>
<td>164</td>
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<tr>
<td>Number of Presentations</td>
<td>193</td>
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<tr>
<td>Number of Invited Presentations/Papers</td>
<td>29</td>
</tr>
<tr>
<td>Number of Invention Disclosures</td>
<td>3</td>
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<tr>
<td>Number of Patent Applications</td>
<td>3</td>
</tr>
<tr>
<td>Number of Collaborations (Outside of UF)</td>
<td>15</td>
</tr>
<tr>
<td>Funding Received by Leveraging NASA Grant</td>
<td>$9.98M</td>
</tr>
<tr>
<td>Dollar Amount of the Proposals Submitted</td>
<td>&gt;$70M</td>
</tr>
</tbody>
</table>
Faculty Bio and Accomplishments

Dr. Samim Anghaie, Nuclear and Radiological Engineering
Professor and Director of the Innovative Nuclear Space Power and Propulsion Institute (INSPI)

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NASA Funding
FY04 Grant

Task Title
Lithium Borohydride for Hydrogen Propellant Storage

Students
1. Anne Charmeau, PhD – Graduation Date: 8/06
2. Michael Liesenfelt, Undergraduate – Graduation Date: 5/06
NASA Funding
FY02, FY03, FY04, FY05 grants

Task Titles
- Zero Boil-Off (ZBO) Pressure Control
- Thermal-Fluid Transport Issues for High Power Density and Gravity Independent Aviation and Space Applications of PEM Fuel Cells
- Two Phase Flow Characteristics and Boiling Heat Transfer Rates During Cryogenic Chilldown and Transport in Reduced Gravity

Students
Task: Zero Boil-Off (ZBO) Pressure Control
1. C. Carvalho, MS – Graduation Date: 5/04
2. Tailian Chen, Post Doctoral Fellow

Task: Two Phase Flow Characteristics and Boiling Heat Transfer Rates During Cryogenic Chilldown and Transport in Reduced Gravity
1. E. Uzgoren, PhD – Graduation Date: 5/06
2. K. Yuan, PhD – Graduation Date: 8/06, currently employed by Doty Scientific Inc. in South Carolina

Task: Thermal-Fluid Transport Issues for High Power Density and Gravity Independent Aviation and Space Applications of PEM Fuel Cells
1. Yan Ji, PhD – Graduation Date: 5/07
2. Yun Whan Na, PhD – Graduation Date: 5/07

Collaborations
InnovaTek Incorporated, Richland WA

Funding Received by Leveraging NASA Grant
$200K, Office of Naval Research STTR Project entitled Dodecane Reforming for SOFCs, Phase II, August 2006 - March 2008, Funding through InnovaTek Inc. Richland, WA.

Publications
Task: Zero Boil-Off (ZBO) Pressure Control

Task: Cryogenic Two-Phase Flow & Heat Transfer in Reduced Gravity

Journal Publications

Conference Papers

Invited Presentations
Dr. Fereshteh Ebrahimi, Materials Science and Engineering
Professor

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NASA Funding
FY02, FY04, and FY05 grants

Task Title
Development of Nanocrystalline Complex Metal Hydrides for Hydrogen Storage

Students
1. Sankara Tatiparti, PhD – Graduation Date: 05/08

Funding Received by Leveraging NASA Grant
NSF funding of $300K for three years in 2006: Nanocrystalline Al-Mg Alloys for hydrogen storage-DMR 0605406.
Dr. Z. Hugh Fan, Mechanical & Aerospace Engineering, Biomedical Engineering
Associate Professor
Address: University of Florida, Department of Mechanic and Aerospace Engineering, P. O. Box 116250, Gainesville, FL 32611-6250
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Homepage: http://aemes.mae.ufl.edu/~hfan/

NASA Funding
FY03, FY04, and FY05 grants

Task Title
Detecting Hydrogen by Enzyme-Catalyzed Electrochemistry

Students
1. Carl K. Fredrickson, MS – Graduation Date: 3/06; Employed by Spirit AeroSystems, Inc.
2. Brent Lutz, MS – Graduation Date: 4/06; Employed by Synkera Technologies Inc.
3. Jackie Viren, MS – Expected Graduation Date: 12/08
4. Zheng Xia, PhD – Expected Graduation Date: 12/08
5. Fernando Tavares, undergraduate student – Graduation Date: 12/04, now in the graduate school of University of Michigan
6. R. Ferguson, undergraduate student – Graduation Date: 5/05; Employed by Progress Energy Inc.
7. Corey Walker, undergraduate student – Graduation Date: 5/07, now in the graduate school of University of California at Irvine
8. Zachery Foster, high school student – Graduation Date: 5/07, now enrolled in UF

Collaborations
1. We collaborated with Dr. Friedrich at the Humboldt University in Berlin, Germany, who provided hydrogenase for the work. We have one co-authored publication.
2. We collaborated with Dr. Cattafesta at the University of Florida. We have one co-authored publication.

Funding Received by Leveraging NASA Grant
One related proposal was funded ($70K) by National Science Foundation (NSF) with proposal No. CHE-0515711. It is entitled “Fluidic Sensors: Integrating Microfluidics with Biological Assays”, covering 8/15/2005-8/14/2006. The proposal was focusing on the enzyme stability.

Patents
One provisional patent application entitled “Hydrogen Sensor Using Enzyme-Catalyzed Reaction” was filed on March 16, 2005 with application No. 60/662,504. A follow-up international PCT was filed on March 16, 2006, with application No. PCT/US2006/009495.
Publications

Journal Publications

Presentations
Dr. Yogi Goswami, Mechanical and Aerospace Engineering
Dr. Yogi Goswami
John and Naida Ramil Professor, and Director, Clean Energy Research Center, College of Engineering, University of South Florida, Tampa.

[Dr. Goswami was the PI for the 1st UF NASA Grant in 2002. At that time he was the Research Foundation Professor of the Dept. of Mechanical and Aerospace Engineering, College of Engineering, University of Florida, Gainesville.]

Address: Rm. 260 ENB (Mail Stop 118 ENB), Clean Energy Research Center, University of South Florida, 4202 E. Fowler Avenue, Tampa, FL 33620

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Home Page: http://cerc.eng.usf.edu
Homepage: http://seecl.mae.ufl.edu/solar http://seecl.mae.ufl.edu/solar/people.html
http://www.mae.ufl.edu/facultylist/ShowData.php?ID=19

NASA Funding
FY02 grant

Task Title
1. Systems Study – Hydrogen Production
2. Indirect Solar Hydrogen Production

Students
1. Nitin Goel, Ph.D.; H₂ thermodynamic cycle – Graduation Date June 2005
2. Allyson Haskell, M.S.; H₂ education modules – Graduation Date December 2003
4. Madhukar Mahishi, Ph.D.; H₂ production and biomass – Graduation Date: December 2006
5. Christopher Martin, Ph.D.; H₂ thermodynamic cycle – Graduation Date: December 2004
6. Gunnar Tamm, Ph.D.; H₂ thermodynamic cycle – Graduation Date: December 2003
7. Bronislava Veltcheva, M.S.; H₂ education modules – Graduation Date: May 2004
8. Sanjay Vijayaraghavan, Ph.D.; H₂ thermodynamic cycle – Graduation Date: May 2004

Publications

Books

Book Chapter

**Journal Publications**


Conference Papers


Dr. Jing Guo, Electrical and Computer Engineering
Assistant Professor

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NASA Funding
FY05 grant

Task Title
Modeling of ZnO Nanorod Hydrogen Gas Sensors

Students

Publications
Dr. David Hahn, Mechanical and Aerospace Engineering
Associate Professor

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Homepage: http://plaza.ufl.edu/dwhahn/

NASA Funding
FY02, FY03, FY04, and FY05 grants

Task Titles
Remote Sensing for Hydrogen Leak Detection
Raman and Rayleigh Scattering for Hydrogen Leak Detection
In Situ Investigation of Major and Minor Species to Support Detailed Model Development of Catalytic Chemistry in a Reformation Reactor

Students
1. Allen Ball, MS, – Graduation Date: 05/05
2. Vince Hohreiter, PhD, – Graduation Date: 12/05
3. Ben Dixon, BS, – Graduation Date: 05/05
4. Amy Twining, MS, – Graduation Date: 12/05

Publications

Collaborations
Modest collaboration with Ocean Optics, Inc.
Dr. Peter Ifju, Mechanical and Aerospace Engineering
Associate Professor

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Phone: (352) 392-6744 Fax: (352) 392-7303

Email: ifju@ufl.edu
Laboratory: Experimental Stress Analysis Lab
Homepage: http://www.mae.ufl.edu/facultylist/ShowData.php?ID=26

NASA Funding
FY02, FY03, FY04, and FY05 grants

Students
1. Donald Myers, MS, Method for Measurement of residual Stress and Coefficient of Thermal Expansion of Laminated Composites – Graduation Date: 12/03
2. William Schulz, MS, Determination of residual stress and Thermal Behavior for Composite Laminates – Graduation Date: 4/05.
3. Lucian Speriatu, PhD, Experimental Characterization of mechanical Properties in Extreme Environments. Received 3rd Place in the Society for Experimental Mechanics National Student Paper Competition – Graduation Date: 07/05
4. Thomas Singer, MS, Received the AIAA, Abe Zarem Award for best Masters Student Paper – Graduation Date: 06/05

Publications
Dr. Gary Ihas, Department of Physics
Professor

Address: 2352 NPB, P.O. Box 118440 Gainesville, FL 32611-844

Phone: 352-392-9244

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Homepage: http://www.phys.ufl.edu/faculty/ihas.html

NASA Funding
FY02, and FY03 grants

Task Title
High Energy Densified Materials

Students
1. Andrew Browne, MS – Supported by Dept. Phys., – Graduation Date: 05/04
2. Kevin Larson, Undergraduate – Graduation Date: 05/04

Publications

Refereed Journal Publications

Conference Papers

**Invention Disclosures**
Mass Gauging of Cryogenic Fluids in Tanks Experiencing Arbitrary Gravity or Acceleration

**Collaboration**
Dr. Herbert A. Ingley, P.E., Mechanical & Aerospace Engineering
Associate Professor

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Homepage: http://plaza.ufl.edu/ingley

NASA Funding
FY02 and FY03 grants

Task Title
The Ammonia - Water Combined Power and Refrigeration Cycle

Students
1. Neha Goswami, Undergraduate; Developed the hydrogen website/graphics for the mobile demonstration unit and hydrogen education modules – Graduation Date: 12/04
2. Samantha Mirabal, MS; Hydrogen production; co-authored book chapter and & several papers/presented at conferences – Graduation Date: 05/04
3. Paul Sathonpattanakij, PhD; Hydrogen production facility – Expected Graduation Date: 12/06
4. Karen Supan, PhD; Hydrogen education modules – Expected Graduation Date: 12/05

Publications

Book Chapter

Journal Publications

Conference Papers
Dr. James F. Klausner, Faculty Coordinator for the NASA Grant
Professor

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NASA Funding
FY02, FY03, FY04, and FY05 grants

Task Titles
High Power Density Thermal Management of Proton Exchange Membrane Fuel Cells
Terrestrial Cryogenic Two-Phase Flow and Heat Transfer Nucleate Flow Boiling Heat Transfer
During Cryogenic Childdown
Cryogenic Transport & Storage (CST)
In-Space Cryogenic Fluid Management Technology Elements

Students
1. Pat Garrity, PhD student. Expected Graduation Date: 07/08
2. Christopher Velat, MS – Graduation Date: 8/04
3. Yusen Qi, PhD – Graduation Date: 1/05
4. Jelliffe Jackson, PhD – Graduation Date: 5/06
5. Patrick Garrity, PhD – Graduation Date: 5/07

Publications

Journal Publications

Conference Papers


Dr. Mark E. Law, Electrical and Computer Engineering
Professor and Chair

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Homepage: http://www.swamp.tec.ufl.edu

NASA Funding
FY03 grant

Task Title
Modeling of a Hydrogen Gas Sensor

Students
1. Scott Oetke, MS – Graduation Date: 05/04
2. Nicole Staszkiewicz, MS – Graduation Date: 05/06

Publications

Conference Papers
**Dr. William E. Lear, Mechanical & Aerospace Engineering**  
Director, Energy & Gas Dynamic Systems Laboratory  
Associate Professor

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P.O. Box 116300 Gainesville, FL 32611-6300

**Phone:** (352) 392-7572  
**E-mail:** lear@ufl.edu  
**Homepage:** http://www.mae.ufl.edu/facultylist/ShowData.php?ID=35

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**NASA Funding**  
FY02, and FY03 grants

**Task Title**  
Fluid Distribution for In-Space Cryogenic Propulsion

**Students**  
1. Sherif Kandil, PhD – Graduation Date: 12/05  
2. Joseph Bray, MS – Graduation Date: 05/03  
3. Brandon Osufsen, MS – left prior to graduation

**Funding Received by Leveraging NASA Grant**  
Received a $2.5M award from the FL State Grant Program to develop “Renewable Energy Fuels in a Micro-Grid Power Module”. The grant will be used to construct a small-scale demonstration plant using the University’s patented PoWER technology, including operation on a variety of liquid and gaseous biofuels. The system allows ultra-clean, efficient operation on a wide variety of biomass fuels, hydrogen or conventional fuels, and this project will be installed at the University of Florida Energy Research Park, connected to the grid by Progress Energy, to determine its performance using biofuels.

**Invention Disclosures**  
Fluid Distribution for In-Space Cryogenic Propulsion

**Publications**

**Journal Publications**  
**Conference Papers**


Dr. Jenshan Lin – Faculty Coordinator for the NASA Grant
Professor, Electrical and Computer Engineering

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Phone: (352) 392-4929
E-mail: jenshan@ufl.edu
Homepage: http://www.rfsoc.ece.ufl.edu/

NASA Funding
FY04, and FY05 grants

Task Title
Integration and Testing of Low Power Wireless Hydrogen Sensor Modules

Students
1. Changzhi Li, PhD – Expected Graduation Date: 08/09
2. Zhen Ning Low, PhD – Expected Graduation Date: 05/10
3. Xiaogang Yu, PhD – Expected Graduation Date: 05/11
4. Jerry Jun, MS – Graduation Date: 05/06
5. Bruce Chou, MS – Graduation Date: 05/06
6. Ahmad El. Kouche, BS – Graduation Date: 05/05

Collaborations
1. Dr. T. Nishida, Dr. K. Ngo (now with Virginia Tech), Dr. J. Guo – Department of Electrical and Computer Engineering
2. Dr. F. Ren – Department of Chemical Engineering
3. Dr. S. Pearton, Dr. D. Norton – Department of Material Science and Engineering
4. Mr. J. Painter – Ford Greenway in Orlando

Funding Received by Leveraging NASA Grant

Patents
Publications

Journal Publications


Conference Papers


Presentations


**Invited Presentations**
Dr. Janise McNair, Electrical and Computer Engineering  
Assistant Professor  

**Address:** 457 Engineering Building, Gainesville, FL 32611-6130  
**Phone:** (352) 392-2629 Fax: (352) 392-0044  
**E-mail:** mcnair@ece.ufl.edu  
**Homepage:** [http://www.wam.ece.ufl.edu/](http://www.wam.ece.ufl.edu/)

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**NASA Funding**  
FY03 and FY04 grants

**Task Title**  
Hydrogen Leak Detection Sensors - Communications and Networking

**Students**  
1. Yuan Guo, PhD – Expected Graduation Date: 05/06  
2. Hetal Patel, PhD – Expected Graduation Date: 05/07

**Funding Received by Leveraging NASA Grant**  
1. National Science Foundation, "Distributed Intersystem Authentication for Multi-Network Environments" ($298K).  
4. National Science Foundation, "I/UCRC (Industry/University Cooperative Research Center). The center is called: Advanced Space Technologies Research & Engineering Center (ASTREC), and it's objective is to transform the culture of the space industry from risk-averse to smartly risk-tolerant. By distributing risk across multiple satellites, ASTREC aims to retain multi-sensor functionality while ensuring that overall capability remains robust (Submitted in Spring 2008.)

**Collaborations**  
- Motorola, Inc.

**Publications**  
Dr. Renwei Mei, Mechanical and Aerospace Engineering
Professor

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E-mail: RWMEI@UFL.EDU
Homepage: http://aemes.aero.ufl.edu/~rwm/

NASA Funding
FY02, FY03, FY04, and FY05 grants

Task Titles
Simulation and Modeling for the Improvement on the Thermal Fluid Management of PEM Fuel Cell
Numerical Investigation of Cryogenic Fluid Transport in Pipelines During Childown Process
Chill Down Process of Hydrogen Transport Pipelines
In-Space Cryogenic Fluid Management Technology Elements

Students
1. Yanxia Zhao, PhD; Recived MS. Moved to Nevada. Switched major to statistics.
2. Jun Liao, Ph.D – Graduation Date: 06/06
3. Jianghui Chao: Received PhD. Post-doc at the University of Florida
5. Hieu H. Tran: Received MS.

Publications

Journal Publications

Conference Papers
1. Multi-Scale Computational Fluid Dynamics with Interfaces, Jianghui Chao, Renwei Mei, and Wei Shyy, 59TH ANNUAL MEETING OF THE DIVISION OF FLUID DYNAMICS, Marriott Tampa Waterside, November 19-21, 2006, Tampa, Florida
NASA Funding
FY04, and FY05 grants

Task Title
Detailed Modeling of Methanol and Ethanol Catalytic Reaction

Students
1. Patrick D. Griffin, MS, Graduation Date: 06/06
2. Weizhong Zhang, PhD – Have not received degree.
3. Hector Leiva – Have not received degree

Publications
3. “Gas Phase Ignition and Extinction of Syngas over a Hot Platinum Surface”, (In preparation)
Dr. Khai D. T. Ngo, Electrical and Computer Engineering
Director, Power Management Group
Professor

Address: Department of Electrical and Computer Engineering
557 NEB, Gainesville, Florida 32611-6130

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URL: http://www.ece.ufl.edu/facultystaff/ngo.html

NASA Funding
FY04 grant

Task Title
Power for Wireless Hydrogen Sensor Network—Energy Harvesters

Students
1. Shengwen Xu, PhD – Graduation Date: 4/07
2. Bharath Kannan, PhD – Graduation Date: 4/07
NASA Funding
FY04, and FY05 grants

Task Title
Co-PI for: Rational Design of Higher Conductivity Solid Oxide Electrolytes

Students
1. Shobit Omar, PhD – Expected Graduation Date: 05/09

Publications

Journal Publications

Conference Papers
Dr. Toshikazu Nishida, Electrical and Computer Engineering
Co-Director, UF-Interdisciplinary Microsystems Group
Associate Professor

Address: Department of Electrical and Computer Engineering
223 Benton Hall, P.O. Box 116200, Gainesville, Florida 32611-6200
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Homepage: http://www.img.ufl.edu

NASA Funding
FY04, and FY05 grants

Task Title
Environmentally - Driven Power Source, Power for Wireless Hydrogen Sensor Network - Energy Harvesters

Students
1. Anurag Kasyap, PhD – Graduation Date: 05/07; PhD Mechanical and Aerospace Engineering, Employed at AdaptivEnergy.
2. Shengwen Xu, PhD, Employed at Intel
3. Alex Phipps, PhD student
4. David Johnson, MS – Graduation Date: 05/06

Collaborations
1. Dr. Rich Waters, Naval Warfare (SPAWAR) Systems Center, San Diego
2. Dr. Donald Blake, Air Vehicles Directorate, Aeronautical Sciences Division, Wright-Patterson AFB/AFRL

Patents

Publications


Dr. David P. Norton, Materials Science and Engineering
Professor

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**NASA Funding**
FY04, and FY05 grants

**Task Title**
Co-PI for: Novel ZnO Nanorod Hydrogen Gas Sensors
Co-PI for: Remote Power Transmission Using High Power GaN HEMTs and Diodes for Regenerative Fuel Cells

**Students**
1. Patrick Sadik – PhD – Graduation Date: 05/08
2. Li Chia Tien – PhD – Graduation Date: 05/07

**Collaborations**
1. SVT Associates, Eden Prairie, MN, contact Dr. Andrei Osinsky.

**Publications**


Conference Papers


Dr. Kenneth K. O, Electrical and Computer Engineering
Professor

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NASA Funding
FY03 and FY04 grants

Task Title
Ultra-wideband Communication for Tiny Low Power Radios

Students
1. Swami Sankaran, PhD – Expected Graduation Date: 12/06

Publications


Dr. Mark E. Orazem - Faculty Coordinator for the NASA Grant
Professor

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NASA Funding
FY04, and FY05 grants

Task Title
A Test Bed for Impedance Measurements on PEM Fuel Cells
Interpretation Models for Impedance Response of PEM Fuel Cells

Students
1. Sunil Roy, PhD – Graduation Date: 05/08
2. Michael Matlock, MS. – Graduation date: 05/06

Publications

Journal Publications

Manuscripts in preparation
   by Impedance Techniques,” manuscript in preparation with submission expected in April 2008.
2. S. K. Roy and M. E. Orazem, “Application of Impedance Techniques to Estimate Interfacial
   Capacitance of PEM Fuel Cells,” manuscript in preparation with submission expected in May
   2008.

Refereed Conference Proceedings
1. S. K. Roy and M. E. Orazem, “Deterministic Impedance Models for Interpretation of Low-
   Frequency Inductive Loops in PEM Fuel Cells,” in Proton Exchange Membrane Fuel Cells 6, T.
   Fuller, C. Bock, S. Cleghorn, H. Gasteiger, T. Jarvi, M. Mathias, M. Murthy, T. Nguyen, V.
   Electrochemical Impedance Spectroscopy,” in Proton Exchange Membrane Fuel Cells 7, T.
   Fuller, H. Gasteiger, S. Cleghorn, V. Ramani, T. Zhao, T. Nguyen, A. Haug, C. Bock, C. Lamy,
Non-Refereed Conference Proceedings

Presentations
Dr. Chang-Won Park, Chemical Engineering
Professor

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NASA Funding
FY04 grant

Task Title
Innovative Design of a Compact Reformer for PEM FC

Students
1. Jing Su, PhD – Graduation Date: 5/08

Patent
A provisional US Patent (Serial No. 60/722,469) was filed the reformer design features in year 2006.
Dr. Steve Pearton, Materials Science and Engineering
Distinguished Professor

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**NASA Funding**
FY03, FY04, and FY05 grants

**Task Titles**
Remote Power Transmission Using High Power GaN HEMTs and Diodes for Regenerative Fuel Cells  
Co-PI for: Novel ZnO Nanorod Hydrogen Gas Sensors  
Co-PI for: Remote Wireless Power Transmission for Regenerative Fuel Cells

**Students**
1. Jon Wright, PhD, Summer intern at NASA Glenn in summer 2007.  Graduation Date: 8/ 2009  
3. Kelly Ip, PhD – Graduation Date: 7/05  
4. Kwang Baik, Ph.D – Graduation Date: 5/04

**Funding Received by Leveraging NASA Grant**
The PI’s have completed a Phase I SBIR ward with Nitronex, Inc. on developing AlGaN/GaN HEMTs on Si substrates and that team has been invited to submit a Phase II proposal. In addition funding from US DOE ($90K), NSF ($82K), US Army ($102K) were received.

**Publications**

Presentations
Dr. Jill Peterson, Mechanical and Aerospace Engineering
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NASA Funding
FY03 grant

Task Title
Rayleigh Scattering for Hydrogen Leak Detection

Students
1. Raghuram Vempati, MS – Graduation Date: 05/04
2. Sameer Paranjpe, MS – Graduation Date: 05/04
3. Philip Jackson, MS – Expected Graduation Date: 06/05
Dr. Simon R. Phillpot, Materials Science and Engineering
Professor

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NASA Funding
FY04, and FY05 grants

Task Title
Co-PI for: Rational Design of Higher Conductivity Solid Oxide Electrolytes

Students
1. Dilpuneet Aidhy, PhD – Expected Graduation Date: 05/08
Dr. Fan Ren, Chemical Engineering
Professor

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NASA Funding
FY03, FY04, and FY05 grants

Task Title
Novel ZnO Nanorod Hydrogen Gas Sensors
Co-PI for: Remote Wireless Power Transmission for Regenerative Fuel Cells

Students
1. Jon Wright, Summer intern at NASA Glenn in summer 2007 and will graduate with a Ph.D in summer 2009
2. Travis Anderson, Interning at Sandia National Labs during summer of 2008 and will graduate with a Ph.D in 5/2008.
3. Hung Ta Wang, PhD – Expected Graduation Date: 05/08
4. Sam Kang, PhD – Expected Graduation Date: 12/05

Collaborations
1. SVT Associates, Eden Prairie, MN, contact Dr. Andrei Osinsky.

Publications
1. Low temperature (<100°C) patterned growth of ZnO nanorods arrays on Si", B.S. Kang, S.J. Pearton and F.Ren, Appl.Phys.Lett.90, 083104 (2007).

Conference Papers


Dr. Bhavani V. Sankar, Mechanical & Aerospace Engineering
Ebaugh Professor, Director, Center for Advanced Composites

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NASA Funding
FY02, FY03, FY04, and FY05 grants

Task Title
Lightweight Composite Tanks for Liquid Hydrogen Storage

Students
1. Wonjong Noh, MS – Graduation Date: 8/04
2. Sujith Kalarikkal, MS – Graduation Date: 8/04
3. Van Pelt III, James, MS – Graduation Date: 12/06
4. Choi, Sukjoo, PhD – Graduation Date: 5/05
5. Nicole Apetre, PhD – Graduation Date: 5/05
6. Jianlong Xu, PhD – Graduation Date: 8/07

Funding Received by Leveraging NASA Grant
1. A stress gradient failure theory for textile structural composites, US Army, $63,833
3. Multi-continuum theory for linerless composite tank design, CTD, Inc., $30,000
4. Uncertainty propagation in the analysis and design of integrated thermal protection system, NASA, $82,853

Publications

Journal Publications


**Conference Papers**


Dr. Gregory Sawyer, Mechanical and Aerospace Engineering
Assistant Professor

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NASA Funding
FY04, and FY05 grants

Task Title
Co-PI for: Multi-scale Surface Plate Fabrication for Next Generation Fuel Cells

Students
1. Jeffrey Bardt, MS – Graduation Date: 8/05, Employed at Samsung
2. Nathan Mauntler, PhD – Expected Graduation Date: 5/09

Publications
NASA Funding
FY04, and FY05 grants

Task Title
Multi-scale Surface Plate Fabrication for Next Generation Fuel Cells

Students
1. G. Bourne, PhD – Graduation Date: 03/06, Employed at UF. Research Assistant Scientist in the Department of Materials Science and Engineering and the Major Analytical Instrumentation Center (MAIC).
2. C. H. Cheng: Received PhD. Interviewing for faculty positions.

Collaborations
(Academic) We have initiated discussions with Dr. Laura Schaefer, Assistant Professor, University of Pittsburgh (Mechanical Engineering Department), regarding a potential collaboration. In this work, we would apply our manufacturing processes to metallic plates that will be used in her micro-PEM/DMFC research.

Funding Received by Leveraging the NASA Grant
The NASA funds were used to leverage follow-on funding from the National Institute of Standards and Technology (NIST). In this two-year project (50K/year for two years - 5/1/06 to 8/30/08), the research collaboration is focused on the development of a reference standard for atomic force microscope (AFM) cantilever stiffness calibration. The end goal is production of flexure-based artifacts that exhibit: low fabrication expense, stiffness adjustability by design, insensitivity to load application point, mechanical robustness, and good reproducibility. Experimental determination of the spring constants of AFM cantilevers is important because the measured forces are inferred from the cantilever displacement and the linear relationship between force and displacement.

Rather than rely on the AFM displacement sensor and various other measurements (of geometry and mass, for example) to determine cantilever stiffness, the purpose of this research is to develop a reference artifact that provides a more direct (force) traceability path. Specifically, it is our intent to design an artifact that can be calibrated using the electronic force balance (EFB) developed by J. Pratt et al. at NIST and subsequently used as a transfer standard to determine the stiffness of commercial AFM cantilevers. Our final design goals for the artifact are:
1. inexpensive to manufacture;
   We will use the micro-molding process for bulk metallic glass.
2. ability to vary stiffness;
Multiple artifacts of varying geometry (and, therefore, stiffness) can be produced in a single mold. Our stiffness design range will be 0.5 N/m to 1.0 N/m, which corresponds both to nominal cantilever stiffness values and the preferred range of operation for the EFB.

3. insensitive to load application location;
   Flexure-based geometries will be applied to reduce/eliminate sensitivity of stiffness to the location of the applied load.
4. mechanical robustness; and
   Because the artifact will be metal and have a size scale of ~1 mm, it will be easier to handle and use.
5. good reproducibility
   We anticipate that the micro-molding process is sufficiently accurate and that the bulk metallic glass properties will be acceptably reproducible to produce the “same” artifact(s) from one mold to the next. This could reduce the number of required EFB measurements once the process reproducibility is verified.

Publications
Dr. Mark Sheplak, Mechanical and Aerospace Engineering
Associate Professor

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NASA Funding

FY04, and FY05 grants

Task Title
Micro-machined Floating Element Hydrogen Flow Rate Sensor

Students
1. Stephen Horowitz, PhD - Expected Graduation Date: 08/05
2. Tai-An Chen, PhD – Expected Graduation Date: 12/08

Collaborations
2. Toshi Nishida and Lou Cattafesta at UF.

Funding Received by Leveraging the NASA Grant
"Moiré-Based Optical MEMS Shear Stress Sensor Technology," Office of Naval Research ($73K).

Publications

Conference Papers
Dr. S.A. Sherif, Mechanical and Aerospace Engineering
Professor
Director, Wayne K. and Lyla L. Masur HVAC Laboratory
Assistant Director, Industrial Assessment Center

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NASA Funding
FY02 grant

Task Title
Liquid Hydrogen Storage Onboard Spacecraft in Microgravity

Students
1. Ahmad M. Mahmoud, MS and PhD, Graduation Dates: 12/04 (MS) and 07/08 (PhD)
2. Midhun Thomas Vergis, MS - Graduation Date: 08/07
3. Sherif Kandil, PhD (Co-Chair), Graduation Date: 05/06
4. Shankar Venkat, PhD, (on sick leave)
5. Kevin Freudenberg, Undergraduate

Publications

Journal Publications

Conference Papers


Dr. Wei Shyy, Mechanical and Aerospace Engineering  
Distinguished Professor (Now with University of Michigan)  

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NASA Funding  
FY02, and FY03 grants  

Task Title  
Cryogenic Two-Phase Flow and Heat Transfer in Reduced Gravity  

Students  
1. Francois, M., PhD, Graduation Date: 8/03  
2. Jackson, J., MS, Graduation Date: 12/03  
3. Uzgoren, E., PhD – Expected Graduation Date: 5/06  
4. Utturkar, Y., PhD, – Expected Graduation Date: 5/06  

Publications  
Dr. Susan Sinnott, Materials Science and Engineering
Professor

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NASA Funding
FY04, and FY05 grants

Task Title
Co-PI for: Rational Design of Higher Conductivity Solid Oxide Electrolytes
Dr. Neil S. Sullivan, Department of Physics  
Professor  
Co-Principal Investigator, National High Magnetic Field Laboratory  

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NASA Funding  
FY02 and FY03 grants  

Task Title  
Ortho-Para Hydrogen Ratiometry  
New Propellants and Cryofuels  

Students  
1. Dr. J. A. Hamida – Post Doctoral Fellow  
2. Dr. D. Zhou, – Post Doctoral Fellow  

Publications  
Dr. Eric. D. Wachsman, Materials Science and Engineering  
Director, Florida Institute for Sustainable Energy  
Director, UF-DOE High Temperature Electrochemistry Center  
Professor  

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NASA Funding  
FY02, FY03, FY04, and FY05 grants

Task Title  
Rational Design of Higher Conductivity Solid Oxide Electrolytes  
Hydrogen Production Using Advanced Protonic Conductor

Students  
1. Jianlin Li, PhD  
2. Dilpuneet S. Aidhy, Ph. D.  
3. Doh Won Jung, Ph. D.  
4. Sun-Ju Song, PhD – Graduation Date:05/03  
5. Ruchita Bagul, MS – Graduation Date:05/04  
6. Jamie M. Rhodes, PhD – Graduation Date:05/05  
7. Guojing Zhang, PhD – Graduation Date:09/05  
8. Tak-keun Oh, PhD – Graduation Date:05/07  
9. Jianlin Li, PhD – Graduation Date:05/08

Post Doctoral Associate  
Dr. Heesung Yoon

Funding Received by Leveraging NASA Grant  
High temperature electrochemistry center: $1.3M  
FL State Center of Excellence – FISE Energy Technology Incubator: $4.5M

Publications  
Task: Rational Design of Higher Conductivity Solid Oxide Electrolytes

Journal Publications  

**Conference Papers**


2. Oxygen Diffusion Mechanism in Cubic Bismuth Oxide using Molecular Dynamics Simulations - The 31st International Cocoa Beach Conference & Exposition on Advanced Ceramics and Composites, Daytona Beach, Florida, January 2007


**Task: Hydrogen Production Using Advanced Protonic Conductor**

**Journal Publications**


2. "Transport Phenomena of SrCe$_{1-x}$Eu$_x$O$_3$. under Hydrogen atmosphere". T. Oh, H. Yoon and E. Wachsman, to be submitted.
3. “Stability of SrCe0.9Eu0.1O3- and SrZr0.2Ce0.7Eu0.1O3- under dry/wet H2 and CO atmosphere,” T. Oh, J. Li, H. Yoon and E. Wachsman, to be submitted.

4. “Tubular-type Proton Conducting Membrane Process and Permeability of SrCe1-xEuxO3-,” T. Oh, H. Yoon and E. Wachsman, to be submitted.


9. “Hydrogen Permeability of SrCe0.95Eu0.05O3- (x = 0.05, M = Eu, Sm)”, S. J. Song, E. D. Wachsman, J. Rhodes, S. E. Dorris and U. Balachandran, Solid State Ionics, 167, 99-105 (2004).


**Conference Papers**


6. “Hydrogen Permeation through Dense SrCe0.9Eu0.1O3- Membrane on Ni-SrCeO3 Tubular Supports,” E. Wachsman, H. Yoon,209th ECS meeting in Denver, Colorado (2006).

7. “Fabrication of Thin Film Eu-doped SrCeO3 Hydrogen Membrane on Ni-SrCeO3 support,” H. Yoon, T. Oh, E. Wachsman, 209th ECS meeting in Denver, Colorado (2006).

9. “The Stability and Permeation properties of SrCe$_{0.9}$Eu$_{0.1}$O$_3$,” T. Oh, H. Yoon, and E. Wachsman, 208th ECS meeting in Los Angeles, (2005)


**Invited Presentations**


Dr. Helena E. Hagelin Weaver, Chemical Engineering
Research Assistant Professor

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NASA Funding
FY04, and FY05 grants

Task Title
Ultrahigh Vacuum Investigations of Bimetallic Catalysts and the Development of Nanoparticle Catalysts for High-Pressure Applications

Students
1. Samuel Jones, PhD – Expected Graduation Date: 5/09
Dr. Jason F. Weaver, Chemical Engineering
Assistant Professor

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NASA Funding
FY04, and FY05 grants

Task Title
Ultrahigh Vacuum Investigations of Bimetallic Catalysts and the Development of Nanoparticle Catalysts for High-Pressure Applications

Students
2. Sunil Devarajan, PhD – Graduation Date: 5/07
3. Luke M. Neal, Ph.D. (partially supported), Expected Graduation Date: 5/09

Publications
2. Steam Reforming of Methanol over CeO$_2$- and ZrO$_2$-Promoted Cu-ZnO Catalysts Supported on Nanoparticle Al$_2$O$_3$, Samuel D. Jones and Helena E. Hagelin-Weaver, Submitted for Publication.

Conference Papers
2. Steam Reforming of CH$_3$OH over ZrO$_2$-Promoted Cu-ZnO/Nano-Al$_2$O$_3$ Catalysts, presented by Helena Hagelin-Weaver at the Florida AVS (American Vacuum Society) meeting, in Orlando, FL on March 11, 2008.
NASA Funding
FY04, and FY05 grants

Task Title
Bimetallic Catalysts for the Electro oxidation of Hydrocarbon Fuels

Students
1. Christina McCall, Undergraduate
2. Casie Hilliard, Undergraduate
3. Marie Correia, Graduate Student
4. Daniel Serra, PhD – Graduation Date: 1/07
5. Corey Anthony, PhD – Expected Graduation Date: 5/06
6. Jianye Zhang, MS – Graduation Date: 05/07
7. Ying Yang, PhD, Graduation Date: 12/04

Publications

Presentations (invited)
1. University of Mississippi, April 17, 2008
2. Jackson State University, June 20, 2008
3. Georgia Southern University (Eminent Scientist Lecture), Nov. 19, 2007
4. University of California, Berkeley February 10, 2004
5. University of Illinois, Chicago September 21, 2004
6. Western Kentucky University November 19, 2004
7. Wayne State University (Frontiers in Chemistry Lecture) April 18, 2005
8. Université Pierre et Marie Curie (Paris 6) September 6, 2005
9. Eastman Chemical Company May 18, 2006

Invited Conference Presentations


Presentations (contributed)

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