

# DOE-NREL Minority University Research Associates Program FY 2005 Accomplishments

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# DOE-NREL Minority University Research Associates Program FY 2005 Accomplishments

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## ABSTRACT

The DOE-NREL Minority University Research Associates (MURA) Program encourages minority students to pursue careers in science and technology. In 2003, eight minority-serving institutions were awarded 3-year subcontracts that began in the summer/fall of FY 2004. This paper lists accomplishments made in the project's first phase.

### 1. Objectives

The MURA program seeks to leverage the research and education contributions of minority-serving institutions in solar energy technology and focuses on encouraging minority students pursuing careers in science and technology. It will also enlarge the scientific and technical knowledge and resource base through partnership and collaboration between universities, NREL, and industry partners. The MURA Program is managed by NREL's National Center for Photovoltaics, which connects the universities to the research programs within this DOE national laboratory. Through this direct link to the NCPV, faculty and students are supported through shared resources, and inclusion in meetings, workshops, and conferences—giving them the unique opportunity to work with and assist NREL staff in ongoing research efforts.

### 2. Technical Approach

Outstanding science and technology majors are selected by faculty at their universities to participate in a solar technology research project during the school year. Students are then awarded internships in industry or at national laboratories during the summer. At the close of the internship, program advisors, students, and host professionals participate in a Renewable Energy Academic Partnership (REAP) review meeting and conference to discuss their research papers and future opportunities.

### 3. Results and Accomplishments

Eight minority-serving universities are completing the first phase of the contracts in the MURA Program this year. The MURA projects produced 38 papers presented or published at major conferences and/or major publications.

During the summer, six students worked at NREL's the National Center for Photovoltaics with NREL researchers/mentors. One NREL intern completed his summer project in collaboration with one of our industry partners. NREL Professionals mentored

NREL Interns and they also attended NREL interns also attended a series of professional development courses and seminars to enhance their training experience.

MURA Program interns planned and executed the REAP Student Summer Research Review Meeting, August 8, 2005, in Vail, CO, held in conjunction with the 15th Workshop on Crystalline Silicon, August 7-10, 2005. Both meetings were well attended by MURA Program participants as well as participants from the Crystalline Silicon Workshop.

The universities, projects and brief accomplishments for 2005 are listed in the publications below.

#### 3.1 Southern University, "Energy Conversion & Storage Devices: Solar Energy Research & Education" Accomplishments:

V. Subramanian et al., Mesoporous SnO<sub>2</sub> synthesized with non ionic surfactants as an anode material for Li-ion Batteries, *J. Nanosci. & Nanotech.* 4, 2, p130-136, 2004.

V. Subramanian et al., Mesoporous RuO<sub>2</sub> as supercapacitor electrode, *Solid State Ionics* 175 (1-4): 511-515, Nov 30, 2004.

V. Subramanian et al., Nanocrystalline SnO<sub>2</sub> and In-doped SnO<sub>2</sub> as anode materials for lithium batteries, *Solid State Ionics* 175 (1-4): 181-184, Nov 30, 2004.

V. Subramanian et al., Synthesis and electrochemical properties of submicron LiNi<sub>0.5</sub>Co<sub>0.5</sub>O<sub>2</sub>, *Solid State Ionics*, 175 (1-4): 315-318, Nov 30, 2004.

S.C. Hall et al., Influence of metal-support interaction in Pt/C on CO and methanol oxidation reactions, *Solid State Ionics* 175 (1-4): 809-813, Nov 2004.

A.M. Stephan et al., Cycling behavior of LiNi<sub>x</sub>Co<sub>y</sub>Mn<sub>2-x-y</sub>O<sub>4</sub> prepared by sol-gel route, *Sol. State Ionics*, 175 (1-4), 2004.

A.L. Despotuli et al., Nano-ionics of advanced superionic conductors, *Ionics* 11, 1 (2005).

W. Zhao et al., Innovative processing of dense LSGM electrolytes for IT-SOFC's, accepted, *J. Pow. Sources*, 2005.

Nanocrystalline La<sub>1-x</sub>M<sub>x</sub>Ga<sub>1-y</sub>N<sub>y</sub>O<sub>3</sub> (M=Sr,Ca, N=Mn,Ni) for IT-SOFC Applications: An exploratory study on solution assisted synthetic routes, H. Jena, Rambabu, submitted, *J. New Mat. Electrochem. Systems* 2005.

S.R.S. Prabaharan et al., Li<sub>4</sub>Ti<sub>5</sub>O<sub>12</sub>/nanoporous carbon black asymmetric hybrid capacitors for pulse power applications, submitted, *J. New Mater. for Electrochem. Systems* 2005.

W. Zhao et al., Nanocrystalline CeO<sub>2</sub> and Gd:CeO<sub>2</sub> synthesized using hydrothermal methods, IMRC-2005.

V. Subramanian et al., Nanocrystalline TiO<sub>2</sub>: a promising anode for Li-ion batteries, accepted, J. Mater. Sci., 2004.

V. Subramanian et al., Mesoporous Fe<sub>2</sub>O<sub>3</sub> and SnO<sub>2</sub> Li-ion Batteries, submitted, J. Mater. Chem., 2004.

3.2 *University of Texas at El Paso*, "Fabrication, Characterization and Modeling of Solar Cells."

Accomplishments:

D. Zubia et al., "Ordered Nanocrystalline Materials for Solar Cell Applications," invited talk, presented at the International Material Research Congress, Cancun, Mexico August 22 – 26, 2004.

J. Terrazas et al., "Ordered Polycrystalline Thin Films for High Performance CdTe/CdS Solar Cells" accepted for publication in Thin Solid Films 2005.

Invited Talk: "Selective-Area Deposition of Ordered CdTe Polycrystal Arrays on SiO<sub>2</sub>/CdS via Close-Spaced Sublimation", D. Zubia et al., XIV International Materials Research Congress, August, 2005.

3.3 *Fisk University*, "Development of Quantum-Dot-Sensitized ZnO and TiO<sub>2</sub> Nanorod-Array Solar Cells."

Accomplishments:

Uniform single-crystalline ZnO nanosheets and nanowires were synthesized by vapor transport and studied by SEM, TEM, and XRD techniques. The results show that nanosheets with a hexagonal structure have uniform plane surfaces with lateral dimensions up to several tens of microns and a thickness of ~100 nm.

H.Y. Xu et al., Ultraviolet electroluminescence from p-GaN/i-ZnO/n-ZnO heterojunction light-emitting diodes," Appl. Phys. B 80, 871–874 (2005).

S. Chen et al., Structural and optical properties of uniform ZnO nanosheets, Adv. Mat. 17, 586 (2005).

H.Y. Xu et al., F-doping effects on electrical and optical properties of ZnO nanocrystalline films," Appl. Phys. Lett. 86, 123107 (2005).

M.H. Wu et al., Production of silicon quantum dots for photovoltaic applications by picosecond pulsed laser ablation," Mater. Sci. & Engin. B 116, 273 (2005).

H.Y. Xu et al., Photoluminescence of F-passivated ZnO nanocrystalline films made from thermally oxidized ZnF<sub>2</sub> Films, J. Phys: Condens. Matter 16, 5143 (2004).

Y.X. Liu et al., Excitonic properties of ZnO nanocrystalline films prepared by oxidation of zinc-implanted silica, J. Phys. D: Appl. Phys. 37, 3025 (2004).

D. Wang et al., The Photoluminescence properties of ZnO:N films fabricated by thermally oxidizing Zn<sub>3</sub>N<sub>2</sub> films using plasma-assisted metal-organic chemical vapor deposition, J. Phys.: Condens Matter 16, 4635 (2004).

J.G. Ma et al., Method of control of nitrogen content in ZnO films: Structural and photoluminescence properties, JVST B 22, 94 (2004).

3.4 *Howard University*, "PV and Renewable Energy Research/Training for Optimal Power Management and Distribution."

Accomplishments:

"Dynamic behavior of PV under different loading conditions," Senior Thesis project, December 2004

Methods for handling dynamics of load in the presence of harmonics," Senior Thesis project, May 2005.

Design and implementation of a reliable PV power management under different loading conditions— Summer 2004 Project.

Design and development of a "PV Based Display Board" with the message: "Howard University, Welcome to CESaC—Summer 2005 Project."

3.5 *North Carolina Central University*, "Investigation of Photovoltaic and Thermoplastic Semiconductors."

Accomplishments:

A compact electron gun for generation of FIR radiation, Proc. 2004 Joint 29<sup>th</sup> Intern. Conf. on Infrared and Millimeter Waves, Sept 27–Oct 1, 2004, Karlsruhe, Germany.

Potentials of SiC as a gyrotron window material, (Invited) Proc. US/Japan/Europe RF Technology Workshop, Amsterdam, Holland, 4-5, Oct 2004

J.M. Dutta, C.R. Jones, Precision measurements of low loss window materials (Invited), Proc. Materials Res. Soc. Fall 2004, Boston, MA.

A. Donev et al., Improving the density of jammed disordered packings using ellipsoids, *Science* 303, 5660, (2004) 990-993.

U. Uzoka, G. Vlahovic, Performance of solar flat plate collectors for Raleigh-Durham area, NC, NCCU, Undergrad. Res. J 7 (2004)36-45.

T. Parsons et al., InAs/GaAs quantum ring in energy dependent particle effective mass approximation, NCCU, Undergrad. Res. J. 7 (2004)46-57.

J. McConnell, J. Dutta, Pulsed laser deposition of microcrystalline silicon, NCCU, Undergrad. Res. J. 7 (2004)58-69.

M.L. Green et al., Numerical solution of electronic properties in quantum dot heterostructures, NCCU, Undergrad. Res. J. 7 (2004)70-76.

3.6 *University of Texas at Brownsville*, "Design, Development, and Implementation of Simulation Tools for Analysis of Solar Concentrating Systems."

Accomplishments:

M.J. Blanco et al., The Tonatiuh software development project: An open source approach to the simulation of solar concentrating systems," submitted, 2005 ASME Intern. Mechanical Engineering Congress and Exposition, Nov 5-11, 2005, Orlando, FL.

M.J. Blanco et al., "Design principles of Tonatiuh, an open source computer program for the design and analysis of solar concentrating systems," Intern. Conf. on Solar Concentrators for the Generation of Electricity or Hydrogen, May 1-5, 2005. Scottsdale, AZ.

3.7 *North Carolina A&T University*, "Performance Testing and Utilization of PV Energy in Residential Environments."

Accomplishments:

A. Shahbazi et al., "Performance evaluation and economic analysis of a multifamily residential building and economic analysis of a grid connected PV residential building," *Appl. Engin. in Agricult.* 21(4): 729-735.

3.8 *Central State University*, "Renewable Energy Technology and Technology Transfer in Developing Countries."

Accomplishments:

Developed and implemented a renewable energy laboratory seminar.

Researched and designed a research-based solar charging station project.

**4. Conclusions**

Minority universities are making significant contributions to research in solar energy technology. The success of the program can be attributed to establishing flexible partnerships managed through the NREL-NCPV, which provides opportunities for faculty and students to assist and develop relationships with professional staff and industry partners.

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**MAJOR FY 2005 PUBLICATIONS**

See citations given under each participating university in Section 3.

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