SD NASA EPSCoR 2009 Major Research Grants (approved for funding Sept. 1, 2009 - Aug. 31, 2012)

South Dakota investigator(s) and affiliation	Project title	NASA funds	NASA and other collaborations
Haiping Hong, Dept. of Materials and Metallurgical Engineering, Jan Puszynski, Dept. of Chemical and Biological Engineering, Wayne Krause, Dept. of Mechanical Engineering, South Dakota School of Mines and Technology; and Xingzhong Yan, Dept. of Electrical Engineering and Computer Science, South Dakota State University **Science PI Haiping Hong, SDSMT**	Improved Thermal Management Systems using Advanced Materials and Fluids	$750,000	Jing Li, Center for Nanotechnology, and Richard Jaffe, Nanotechnology Branch, Space Technology Div., NASA Ames Research Center, NCH Corporation, Zyvex Performance Materials, Univ. of California, San Diego, Univ. of Colorado, Boulder
Steve Smith and Phil Ahrenkiel, Nanoscience and Engineering Program, and Zhengtao Zhu, Dept. of Chemistry, South Dakota School of Mines and Technology; and Qiquan Qiao, David Galipeau and XingZhong Yan, Dept. of Electrical Engineering, South Dakota State University **Science PI Steve Smith, SDSMT**	Development of an Advanced Photovoltaic Materials Research Cluster in South Dakota	$750,000	Sheila Bailey and Eric Clark, Photovoltaics Branch, NASA Glenn Research Center, Andrew Norman, National Renewable Energy Laboratory, Seth Darling, Argonne National Laboratory, Danielle Merfeld, GE Global Research, Gregory Nelson, Olamco Solar

Abstracts
(Funded South Dakota NASA EPSCoR 2009 Major Research Projects)

Improved Thermal Management Systems using Advanced Materials and Fluids

Heat transfer properties of fluids can be significantly enhanced by dispersing nanoparticles (e.g. carbon nanotubes and/or metal oxides). The proposed project is to develop a nanofluid thermal management system concept and methodology to enhance thermal conductivity significantly for coolant applications.

The scientific merit of this proposal is based on recent results that the thermal conductivity (TC) of heat transfer nanofluids containing magnetically sensitive metal oxide nanoparticles and magnetically sensitive metal coated carbon nanotubes can be significantly enhanced (>60%) by applied magnetic field. A reasonable explanation for these interesting TC enhancements is that magnetically sensitive particles form aligned chains under an applied magnetic field, which improves thermal conductivity via increased contacts. The proposed research could lead to more than 100% stable TC enhancement in the nanofluids while keeping the viscosity relatively low (similar to water).

Nanofluids with enhanced thermal properties, low viscosity, and long-time stability are a very promising, yet challenging field with considerable potential and demand from both NASA and commercial applications. They can be used in the NASA (air) flight cooling systems, automotive engine cooling systems, and any other current cooling systems based on water and ethylene glycol. Also, the fundamental concept (magnetic field aligned nanotubes) could be used in many other applications, such as the development of thermally conductive films, reinforced polymer composites, transparent electrodes for display and solar cells, new sensors, and other applications. The project has both scientific and commercial value, not only for the benefit of NASA, but also the whole US industry (aircraft and automotive industry).

Development of an Advanced Photovoltaic Materials Research Cluster in South Dakota

The project will catalyze the formation of an Advanced Photovoltaic Materials Research Cluster, uniting inorganic/organic materials-based solar cell researchers at SDSU and SDSM&T with semiconductor physicists / nano-scientists at SDSM&T. This group will focus on developing materials and device concepts for next generation solar cells, that is, ultra-high efficiency materials and device concepts for future solar electric generation. The team will explore advanced concepts utilizing organic and inorganic semiconductors, and their nano-structures. The over-reaching goal is to maximize the conversion of solar photons to electrons while minimizing intrinsic losses inherent in the solar conversion process. Bandgap engineered materials based on inorganic nano-structures, broad absorption bandwidth polymers, and composite organic / inorganic materials will be developed. Nanostructured electron acceptors for hybrid solar cells will be developed. The intermediate band concept applied to inorganic semiconductors, as well as organic based absorbers, will be explored. A major goal of the project will be infrastructure improvement, with the goal of supporting undergraduate and graduate students in state-sponsored PhD programs in Nanoscience and Engineering, and Electrical Engineering, with a focus on photovoltaics, a field critical to spacecraft and space exploration. The research team will work on topics synergistic to, and in collaboration with, activities of the photovoltaics group(s) at NASA Glenn. This interaction will be used to strengthen recruiting of students to these programs, by offering opportunities for undergraduate and graduate research in collaboration with NASA. The project will foster a symbiotic relationship with NASA, by creating recruitment opportunities for NASA research centers. The project will build infrastructure and expertise in high-efficiency photovoltaic materials and device research, making South Dakota researchers more competitive for follow-on funding, and creating economic development opportunities through the PI's involvement in the solar cell industry, SBIR and STTR funding opportunities for small businesses.

Back to SD NASA EPSCoR Homepage <http://sdspacegrant.sdsmt.edu/nasaepscor.htm>