MUREP Small Business Technology Transfer (M-STTR) Planning Grants

Title: UV Protective Coating for Photovoltaic Solar Cells in Space
Institution: Oakwood University
City/State: Huntsville, AL
PI: Dr. Darayas Patel

SUMMARY: Space stable flexible thin film coatings are required by NASA to replace cover glass in flexible solar blankets made of thin film solar cells for novel compact and light-weight solar array deployment systems. Existing transparent coatings exhibit unacceptable UV darkening and may not provide enough radiation shielding. Dr. Darayas Patel from Oakwood University (OU), the PI, and his collaborator Dr. Sergey Sarkisov from small business concern (SBC) SSS Optical Technologies (SSSOT) propose to develop the Polymer Anti-damage Nanocomposite Down-converting Armor (PANDA) technology of coating PV cells that, in addition to blocking UV radiation and being stable, flexible and light weight, down-converts UV into visible and near-infrared (NIR) radiation to generate extra electricity thus improving the overall PV efficiency by up to 5%. PANDA technology will be based on transparent polyimide coating enhanced by luminescent nanoparticles made of rare-earth (RE) compounds to reduce UV degradation of flexible solar blankets and increase their efficiency using UV to visible-NIR down-conversion. The innovativeness of the technology is in twofold: (1) protection from UV degradation is combined with the use of the UV energy, otherwise wasted, in the production of additional PV electricity and (2) solar spectrum down-conversion from UV to visible-NIR is conducted with the nanoparticles of inexpensive, environment friendly, and efficient RE compounds. The goal of the project is to prepare the team to the submission of STTR Phase I proposal to NASA in FY2022. The goal will be achieved though attaining the following objectives: (1) Identification of the potential approaches to synthesis of the down-converting phosphor. (2) Identification of the potential approaches to characterization of the phosphor. (3) Identification of the methods of making PANDA coatings. (4) Methods of testing PANDA coatings. (5) Developing the draft of STTR proposal. (6) Training of an African American minority student at OU and preparing to the work on STTR Phase I project in case it will be funded. The project will include Task 1: Synthesis of RE phosphor; Task 2: Phosphor characterization; Task 3: Building prototype; Task 4: Testing prototype; and Task 5: Drafting STTR Phase I proposal. If successful, the developed coating will enable space-stable lamination of solar blankets and thin film solar cells while achieving additional 5% relative efficiency boost. This will help to meet NASA goals for solar array specific power (200-250 W/kg) and stowed volume efficiency (50-200 kW/m3). The focus of the collaboration will be on NASA SBIR-STTR Focus Area 2: Power, Energy and Storage, Subtopic S3.01 Power Generation and Conversion. This subtopic is seeking “photovoltaic (PV) cell and blanket technologies that lead to significant improvements in overall solar array performance for missions in areas of scientific interest including … high-radiation environments”. State-of-the-art (SOA) photovoltaic array technology consists of high efficiency, multijunction cell technology on thick honeycomb panels and, as of late, lightweight blanket system employable systems. Current solution for high-radiation intensity involves adding thick cover glass to the cells, which increases the overall system mass. The project will address the current gaps between SOA and mission requirements for photovoltaic cell efficiency >30% and array mass specific power >200 W/kg. One of the major potential non-NASA applications of the technology in the government and commercial sectors is the improvement of the efficiency of solar PV panels while protecting them from harmful UV radiation of the Sun and increasing their lifetime. By 2050 the annual PANDA product sales globally and in US/North America are expected to reach $3.99B and $798M, respectively.