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Hybrid Electronic Materials Studied for Energy/Aerospace Applications

Theda Daniels-Race, associate professor of the LSU Department of Electrical and Computer Engineering and the Center for Computation & Technology, has received $30,000 from the Louisiana Board of Regents - NASA EPSCoR Program to investigate the electrical characteristics and environmental sensing capabilities of hybrid nanomaterials, or HNMs, as synthesized from ionic liquids or ILs.

Daniels-Race's proposal titled "Hybrid Electronic Materials for Energy/Aerospace Applications" was funded for a one year period and conceives that the electrical and physiochemical properties of IL-HNMs are indicative of their utility in energy (e.g. fuel cells, solar) and aerospace (e.g. atmospheric sensing) applications.

Motivated by the recent discovery and development of a new form of nanoparticle by Isiah M. Warner of the LSU Department of Chemistry—synthesized frozen ILs in nanoparticle form—this study of IL-HNMs will represent a first-time investigation of the utility of these nanoparticles for electrochemical energy storage and environmental sensing as it relates to aerospace applications.

"Preliminary results indicate that the IL-HNMS are potential candidates for the improvement of existing solar cells by replacing indium tin oxide (ITO), a transparent, highly conductive material used in dye sensitive solar cells (DSSCs)," said Daniels-Race. "ITO films are brittle and subject to device contact problems—they are also expensive. Conductive polymer alternatives to ITO degrade over time. Other alternatives to ITO include cadmium sulfide and cadmium selenide quantum dots. These work well for their emission spectra tunability but are damaging to the environment. The cation-anion pairings of IL-HNMs provide a better, greener level of power, without the cost of ITOs and the dangers of cadmium."

The Warner Group IL-HNMs have been used in the detection of six different VOCs (volatile organic compounds). "This finding opens the door to not only a facile and affordable means of molecular weight determination but also to explosives detection, chemical weapons detection and discrimination, and biological species detection," said Daniels-Race.

Directly benefiting present and next-generation energy and environmental needs of vehicles for both air and space (and conceivably land transportation as well), the potential research findings of the IL-HNMs open up opportunities to improve and newly engineer devices (e.g. solar cells, chemical sensors) whose energy and environmental applications are critical to the advancement of NASA goals with respect to aeronautics research.

For more information on this research, please visit: http://www.cct.lsu.edu/home.

Publish Date:
08-22-2011

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