RESEARCH FOCUS ON DR. FATIMA AMIR

Energy storage is a key element in modern energy supply chain and is becoming an imperative part of renewable energy. Energy storage technologies are used in modern grids for a variety of applications and with different techniques. The range of applications and technologies is very broad, and finding the right storage solution for the job at hand can be difficult.

The most promising energy storage systems have been lithium-based batteries, however today's batteries even when holding large amounts of energy, can take hours to charge. They also have a limited life cycle, and problematic safety features.

Bridging conventional capacitors and batteries, super-capacitors are widely considered to be a feasible solution for next-generation energy storage challenges because

NSF EPSCoR RII Track-1 MADE in SC
The vision of the Materials Assembly and Design Excellence in South Carolina (MADE in SC) initiative is to discover and establish new and sustainable approaches for the design and assembly of hierarchical materials at multiple relevant length scales that serve South Carolina's STEM research, education and workforce needs and invigorate economic development.

Dr. Amir is a member of the Thrust 1 (Hierarchical Structures with Controlled Optical and Magnetic Properties) team. The goal of Thrust 1 is to develop the fundamental computational and experimental science to guide the development of materials that exhibit designed optical and magnetic properties not attainable in current materials.

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of their high power density, long lifespan, and relatively low cost. Potential applications of supercapacitors are load leveling functions for batteries in electric vehicles during starting, acceleration and regenerative braking, and burst power generation in electronic devices such as cellular phones and navigational devices.

Supercapacitors are power devices that can be fully charged or discharged in seconds; as a consequence, their energy density (about 10Wh kg^{-1}) is lower than in batteries, but a much higher power delivery or uptake (10 kW kg^{-1}) can be achieved for shorter times (a few seconds). The electrode is the key element in the supercapacitors fabrication; therefore, the current research is mainly concerned with the optimization of the existing electrode materials and the development of new materials to improve energy density of supercapacitors.

Dr. Fatima Amir and her undergraduate students at **Winthrop University**, have fabricated transition metal/graphene oxides all solid–state supercapacitors with outstanding energy densities, and are working on developing new electrodes materials for supercapcaitors, investigating their electrochemical performance, and maximizing their energy density.

The project integrates an educational component where undergraduate students take a research class (PHYS 351 and PHYS 352) during spring and fall, and learn about fabrication and characterization of supercapacitors.

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