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Multifunctional Graphene-based Hybrid Nanomaterials for Electrochemical Energy Storage.[1] SANJU GUPTA, Western Kentucky University — Intense research in renewable energy is stimulated by global demand of electric energy. Electrochemical energy storage and conversion systems namely, supercapacitors and batteries, represent the most efficient and environmentally benign technologies. Moreover, controlled nanoscaled architectures and surface chemistry of electrochemical electrodes is enabling emergent next-generation efficient devices approaching theoretical limit of energy and power densities. This talk will present our recent activities to advance design, development and deployment of composition, morphology and microstructure controlled two- and three-dimensional graphene-based hybrids architectures. They are chemically and molecularly bridged with carbon nanotubes, conducting polymers, transition metal oxides and mesoproprous silicon wrapped with graphene nanosheets as engineered electrodes for supercapacitor cathodes and battery anodes. They showed significant enhancement in terms of gravimetric specific capacitance, interfacial capacitance, charging-discharging rate and cyclability. We will also present fundamental physical-chemical interfacial processes (ion transfer kinetics and diffusion), imaging electroactive sites, and topography at electrode/electrolyte interface governing underlying electrochemical mechanisms via scanning electrochemical microscopy.

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