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# Nanostructured carbons: Materials for the advanced future energy

Environmental and economic concerns have caused urgent transitions of fossil fuel-based automotive-vehicles to hybrid-vehicles and, now to fully electric vehicles. In general, the expected driving range of electric vehicles is dependent upon energy density of the batteries. Although batteries provide high energy density, they suffer from several drawbacks such as low power density, safety, limited life cycle, longer charging and discharging cycles, and recyclability. To overcome these drawbacks, supercapacitors are emerging as novel energy storage devices with significantly higher power density compared to batteries. For example, hybrid transit buses in China operate using supercapacitors packs, which estimates to provide improved fuel economy up to 30-50%. Using supercapacitors could also provide the additional advantage of energy regeneration while braking, instead of thermal loss and add to improved fuel economy. In this talk, we will report synthesis, characterization and energy applications of nanostructured carbon. Our research showed that various forms of carbon such as bio-waste derived carbon, graphene, composite of graphene could be used for energy storage as well as energy production via water splitting. Water splitting generates hydrogen which could be used as a green fuel. For example, carbon derived from tea leaves could for Li-ion supercapacitors. The energy storage capacity depends on the electrolyte and temperature. Carbon from tea showed a specific capacitance of 292 and 246F/g in 3M KOH and LiOH electrolyte, respectively with outstanding cyclic stability (100% capacitance retention up to 5,000 cycles). A supercapacitor device fabricated using bio-derived carbon should about 95% retention in charge storage capacity on increasing current density from 1 to 12mA/cm$^2$, confirming high rate stability of the supercapacitor. It was further noted that charge storage capacity increases with increase in temperature. Our studies suggest that nanostructured carbon could be used for an electrode in next-generation energy storage and production devices.

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## Biography

Ram Gupta is an Associate Professor of Chemistry at Pittsburg State University, USA. His research focuses on green energy production and storage using carbon, conducting polymers and composites, nanomaterials, optoelectronics and photovoltaics devices, organic-inorganic hetero-junctions for sensors, nanomagnetism, bio-based polymers, bio-compatible nanofibers for tissue regeneration, scaffold and antibacterial applications, bio-degradable metallic implants. He has published over 180 peer-reviewed journal articles, made over 200 national/international/regional presentations, chaired many sessions at national/international meetings, and received over 1.5million dollars for research and educational activities from external agencies such as NSF, DoE, KINBRE. He is serving as Associate Editor and editorial board member for various journals.

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