Improving the Science of Energy Storage

Amit Paul*
Department of Chemistry, IISER Bhopal, MP, INDIA
(E-mail: apaul@iiserb.ac.in)

Abstract: Electrochemical supercapacitors are emerging as devices of prime importance because of its potential applications in short term power boosts, emergency power supplies, and peak power assistance for batteries. Supercapacitors are classified into two categories. The first one is electrical double layer capacitor (EDLC) wherein charge storage arises due to ion adsorption at the electrode-electrolyte interface while the second category of capacitors are pseudocapacitors where charge storage arises due to electron transfer between electrode-electrolyte interfaces. One of the major focuses of my research group is to introduce new scientific strategies for energy storage/supercapacitor application. In this talk, I will provide few examples to highlight fundamental scientific concepts that can be incorporated to improve specific capacitance of a supercapacitor. First, I will discuss the synthesis of highly conducting graphene and the role of graphene's electrical conductivity towards superior energy storage. In the second example, role of edge functionalities of graphene towards improvement of specific capacitance will be discussed. In the third example, I will highlight the importance of interconnectivity between MnO_2 nanoparticles that can improve mass transfer significantly inside the pores of materials and hence charge storage was enhanced. Fourth example will highlight physisorption of hydroquinone on activated charcoal as a supercapacitor material wherein intermolecular hydrogen bonding between oxides sites of activated charcoal and hydroquinone provided the redox stability to hydroquinone moiety and improved the capacitor performance. In the last example, covalent organic frameworks (COFs) performance as a capacitor will be discussed. In this example, intramolecular hydrogen bonding between hydroquinone and secondary amine provided the redox stability for hydroquinone.

References and Notes:

1. Singh, C.; Mishra, A. K.; Paul, A. *J. Mater. Chem. A* **2015**, *3*, 18557.
2. Singh, C.; S. N.; Jana, A.; Mishra, A. K.; Paul. A. *Chem. Commun.* **2016**, *52*, 12661.
3. Singh, C.; Paul, A. *J. Phys. Chem. C* **2015**, *119*, 11382.
4. Maqbool, Q.; Singh, C.; Jash, P.; Paul, A.; Srivastava, A. *Submitted.*