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Polymeric Composites with Synergetic Carbon and Layered Metallic Compounds for Supercapacitor Application

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Abstract : In this technologically driven world, it is requisite to develop better, faster and smaller electronic devices for various applications to keep pace with fast developing modern life. In addition, it is also required to develop sustainable and clean sources of energy in this era where the environment is being threatened by pollution and its severe consequences. Supercapacitor has gained tremendous attention in the recent years because of its various attractive properties such as it is essentially maintenance-free, high specific power, high power density, excellent pulse charge/discharge characteristics, exhibiting a long cycle-life, require a very simple charging circuit and safe operation. Binary and ternary composites of conducting polymers with carbon and other layered transition metal dichalcogenides have shown tremendous progress in the last few decades. Compared with bulk conducting polymer, these days conducting polymers have gained more attention because of their high electrical conductivity, large surface area, short length for the ion transport and superior electrochemical activity. These properties make them very suitable for several energy storage applications. On the other hand, carbon materials have also been studied intensively, owing to its rich specific surface area, very light weight, excellent chemical-mechanical property and a wide range of the operating temperature. These have been extensively employed in the fabrication of carbon-based energy storage devices and also as an electrode material in supercapacitors. Incorporation of carbon materials into the polymers increases the electrical conductivity of the polymeric composite so formed due to high electrical conductivity, high surface area and interconnectivity of the carbon. Further, polymeric composites based on layered transition metal dichalcogenides such as molybdenum disulfide (MoS2) are also considered important because they are thin indirect band gap semiconductors with a band gap around 1.2 to 1.9eV. Amongst the various 2D materials, MoS2 has received much attention because of its unique structure consisting of a graphene-like hexagonal arrangement of Mo and S atoms stacked layer by layer to give S-Mo-S sandwiches with weak Van-der-Waal forces between them. It shows higher intrinsic fast ionic conductivity than oxides and higher theoretical capacitance than the graphite.

Keywords : supercapacitor, layered transition-metal dichalcogenide, conducting polymer, ternary, carbon
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