Self-assembled Mesoporous Nano- or Microstructure for Energy Storage and Sensing Application

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Fullerenes C_{60} or C_{70} could be effective building blocks as they are composed by sp^2 carbon atoms with extended conjugation of π-electrons and readily undergoes supramolecular self-assembly forming various microstructures from zero to higher dimensions.[1-3] These self-assembled fullerene micro/nanostructures can freely be controlled by solvent engineering and temperature change. Introduction of pores (micro-, meso-, or both) in fullerene crystals drastically increases the effective surface area leading to great utility in energy storage and sensing applications.[1,3] Here, we present the fabrication of dimensionally controlled fullerene micro/nanostructures by simple liquid-liquid interfacial precipitation method (LLIP). These fullerene micro/nanostructures could be directly transformed into mesoporous structure by high temperature (900 °C) heat treatment or chemical modification. Heat treated mesoporous carbon derived from fullerene having π-electron conjugation within the sp^2-carbon with robust frameworks shows excellent electrochemical supercapacitive performance far better than commercial active carbons or nanocarbons such as graphene. Porous fullerene micro/nanostructure performs as an excellent sensing system for volatile organic compounds (VOCs) owing to their easy diffusion through the mesoporous architecture and strong π-π interactions with the sp2 carbon-rich pore walls. Porous fullerene structure has been used as sensing system in conjunction with a quartz crystal microbalance (QCM)[4] and with nanomechanical Membrane-type Surface tress Sensor (MSS).[5]

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