**Functional carbon fibres and particles with hierarchical porosity**

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Synthesis of mesoporous carbon nanospheres with well-defined pore arrangement is very attractive due to their excellent properties such as large surface area, chemical stability and hydrophobicity. Our research is mainly focused on the development of nanostructured carbon materials include, fabrication of 1D, 2D and 3D carbon structures via appropriate solution and blending processes for various applications. In our recent study, we have prepared novel, continuous carbon fiber precursors mimicking the industrial processing by wet spinning technology using polyacrylonitrile (PAN)/liquid crystalline graphene oxide (LCGO).1 Novel in this study include unexplored production of PAN composite fibers with addition of very low percentage of LCGO without using any surface modifications or coating. The LC behavior in the solution enables a significant enhancement in mechanical properties of the PAN/LCGO composite fibers; that is, a 115 % improvement of tensile strength and 152 % increase of tensile modulus are achieved at a filler loading of 0.5wt % whereas 138 % improvement in tensile strength at 1 wt % of LCGO. By introducing competitive hydrogen-bonding interactions and self-assembly among precursor polymers, porous carbon fibers with a highly ordered, tunable porous architecture were produced. The process involves a series of optimized techniques including reactive polymer blending, wet spinning, and carbonization. These fibers have potential energy density and high electron/ion charging rates properties, which are typically mutually exclusive in electrochemical energy storage devices. More recently, we have demonstrated that these highly porous functional fibres can be made from waste materials such as ‘chicken feet’.2 We have successfully developed a facile method for synthesizing tunable mesoporous carbon spheres without the use of strong acid or base. MCN with very high surface area, uniform pore size, and high thermal stability were achieved by simply adjusting the ratio between the block copolymer to phenol without using any activating agents.3 The concept is based on inter polymer interactions between block copolymer and the carbon precursor, thus leading to a highly stable complex compared to analogous systems. Making use of the hydrogen bonding interactions between the functional groups of the block copolymer and phenol, this study created highly stable, tunable nanoparticles with excellent surface area and uniform morphologies that were further demonstrated for their target applications as electrodes for lithium ion batteries.

**References**

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