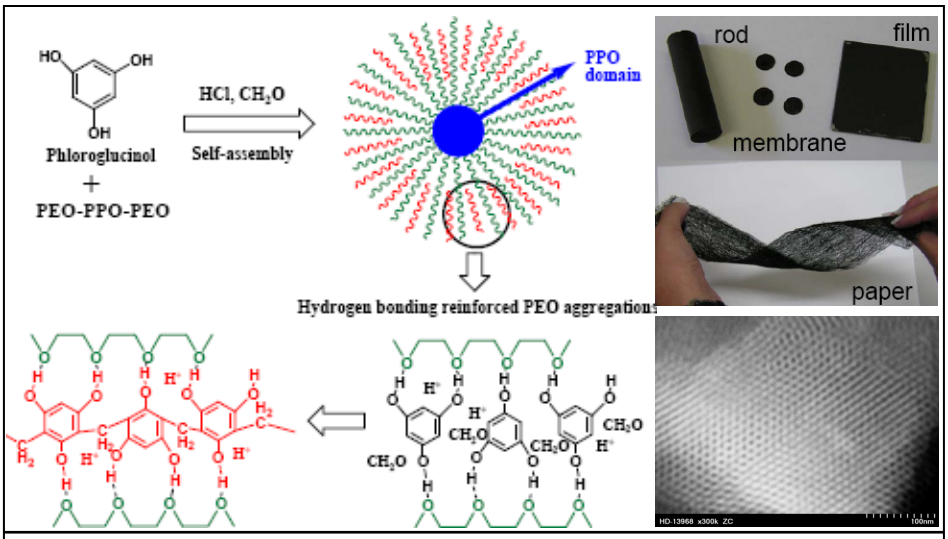
Self-Assembled, Nanostructured Carbon for Energy Storage and Water Treatment

Through fundamental research at Oak Ridge National Laboratory, a unique approach was devised for synthesis of self-assembled nanostructured carbon materials. The properties of these materials – tunable pore size and structure in the range of 2 to 12 nanometers, high specific capacitance, excellent electrical conductivity, and high chemical purity – make these materials attractive for energy-related applications. These carbon materials are being examined for use in electrodes for two important, large scale applications: electrochemical double-layer capacitors (commonly called "ultracapacitors" or "supercapacitors") for electrical energy storage and capacitive deionization (CDI) systems for water treatment. Potential applications for ultracapacitor technology includes transportation (hybrid automobiles and rail systems), the electrical grid (stability and power quality), renewable energy (solar and wind), and consumer electronics. CDI separation technologies have a very large potential market in water treatment systems, including seawater desalination, and treatment of oil and gas produced water. Current work in the Industrial Technologies Program of DOE seeks to translate this technology from laboratory scale to commercial application. Issues being addressed include the optimization of process variables to achieve desired product properties, recycling the costly chemicals used as templates for structuring the carbon, adapting the process to employ inexpensive, renewable feedstocks, and scale-up of production.



Left: Scheme of the self-assembly of phloroglucinol/ formaldehyde copolymer in the hydrophilic domains of PEO-PPO-PEO triblock copolymers.
Top right: Mesoporous carbons in different forms: Rod, film, membrane, fiber, paper.
Bottom right: Transmission electron microscopy (TEM) image of mesoporous carbon.

Liang, C. D.; Dai, S. *Journal of the American Chemical Society*, 2006, 128, 5316-5317.

Patents or other steps toward commercialization: Two industrial partners are actively collaborating in R&D toward commercialization; the efforts are based on U.S. patent application 2006057051.

Contributing Agencies: DOE