Hierarchically Ordered Porous Carbon Films for Commercial Water Desalination

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Technology Summary

Porous carbon films that can be optimized and assembled as electrodes in a device to desalinate water have been successfully produced at ORNL. The new porous carbon has a controlled, well-ordered hierarchy of pore sizes that readily adsorbs materials in industrial desalination processes. Unlike existing films, these carbon films can readily be produced in a batch-to-batch, repeatable, and uniform way on a commercial scale.

Porous carbon materials have long been used in capacitive deionization (CDI) technology. This process is growing in popularity for large-scale desalination operations because of its lower operating costs, but existing porous carbons are hampered by both microporous and broad mesoporous size distributions and cannot be readily improved. Existing films also have significantly lower capacity for kinetic adsorption. The ORNL invention offers both a method for making new, hierarchically ordered porous carbon films and describes a capacitive deionization device in which the material is incorporated.

Advantages

- Provides an inexpensive method of desalinating seawater and brackish water worldwide to meet the increasing need for potable water
- Alleviates mass-transport limitations of micropores and provides a network for larger solution volumes (i.e., electrolyte, brackish water, etc.) to flow through the porous mesoporous carbon material
- Can further increase surface area and pore volume by activating mesoporous material to produce micropores
- Does not require the use of formaldehyde, a known toxin and carcinogen

Potential Applications

- Capacitive deionization electrode material for desalination of large volumes of water
- Supercapacitor electrode material, separations material, battery electrode material, catalyst support

Patent

Sheng Dai and Richard T. Mayes. *Carbon Composition with Hierarchical Porosity and Methods of Preparation*, U.S. Patent Application 13/046,836, filed March 14, 2011.

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