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Biomass-based carbon electrode materials for capacitive deionization: a review

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Abstract

Capacitive deionization (CDI) is a promising water purification technology which works by removing salt ions or charged species from aqueous solutions. Currently, most of the research on CDI focuses on the desalination of water with low or moderate salt concentration due to the low salt adsorption capacity of the electrodes. The electrosorption capacity of CDI relies on the structural and textural characteristics of the electrode materials. The cost of electrode materials, the complicated synthesis methods, and the environmental concerns arising from material synthesis steps hinder the development of large-scale CDI units. By considering the good electrical conductivity, high specific surface area (SSA), porous structure, availability, mass production, and cost, porous carbon derived from biomass materials may be a promising CDI electrode material. This review presents an update on carbon nanomaterials derived from various biomasses for CDI electrodes. It covers different synthesis methods and the electrosorption performance of each material and discusses the impact of the SSA and porous structure of the materials on desalination. This review shows that a variety of biomass materials can be used to synthesize cost-effective CDI electrode materials with different structures and good desalination performance. It also shows that diverse precursors and synthesis routes have significant influences on the properties and performance of the resulting carbon electrodes. Additionally, the performance of CDI does not depend only on BET surface area and pore structure but also on the applied voltage, initial concentration of the feed solution, and mass, as well as the capacitance of the electrodes.

Keywords
Capacitive deionization; Water desalination; Porous carbon; Biomass; Specific capacitance; Electrosorption capacity