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Analysis of Manganese Dioxide Electrochemical Capacitors using Synchrotron Methods: Determining the Effects of Material Properties on Electrochemical Performance

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Energy storage devices are an increasingly important technology due to the growing demand for energy. This demand, combined with the depletion of non-renewable resources, has increased the need for renewable energy and energy-saving technologies. These systems rely heavily on energy storage. Renewable energy sources, including wind and solar power, require storage to mitigate the effects of a fluctuating energy supply and energy storage devices can increase energy efficiency in many applications.

Electrochemical capacitors (ECs) are a promising energy storage device due to their good performance, safety and reliability. ECs store charge in the electrical double layer formed at the interface between an electrolyte and a polarized electrode. In manganese dioxide electrodes, fast, reversible redox reactions also take place which contribute to its high capacitance.

The charge storage capabilities of manganese dioxide are influenced by material properties including crystal structure, pore size distribution, surface area and morphology [1, 2]. Improving electrode performance relies on understanding the effects of material properties on performance. In this work, we focus on characterising manganese dioxide in both the material synthesis stage and during electrode cycling using SAXS and powder diffraction. By determining the effects of the synthesis conditions on material properties, and furthermore, the effects of material properties on performance, we aim to optimise the performance of these devices.

1. M. Dupont, A. F. Hollenkamp and S. W. Donne, Electrochimica Acta, 104 (2013) 140-147
2. M. F. Dupont and S. W. Donne, Journal of The Electrochemical Society, 162 (2015) A5096-A5105

Keywords

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