



Contribution ID: 65

Type: Poster

In-situ examination of electrodeposited manganese dioxide electrodes for energy storage applications: a combined small angle x-ray scattering and powder diffraction study.

Thursday, 20 November 2014 17:30 (1h 30m)

Manganese dioxide is used in many electrochemical applications including catalysis, batteries and electrochemical capacitors. Thin film manganese dioxide electrodes prepared by electrodeposition have been shown to have extremely high capacitive performance [1]. This is due to manganese dioxide thin films having low resistance and high surface area. However, these properties diminish markedly as film thickness increases. Hence, understanding how the deposition mechanism causes this effect is vital for improving material performance.

In order to determine the relationship between deposition mechanism, material properties and electrochemical performance, thin film formation under different deposition conditions must be examined. In this work, the deposition of manganese dioxide was examined in-situ using two different methods; namely small angle X-ray scattering (SAXS) and powder diffraction (PD).

The morphology of manganese dioxide thin films is expected to affect their performance as it influences porosity and surface area. SAXS was used to characterise the surface morphology of manganese dioxide, specifically features such as pore size and particle size in the < 1 nm size range. The crystal structure also affects the electrochemical performance of manganese dioxide via the conductivity (ionic and electronic) of different crystal phases of manganese dioxide [2]. The crystal structure of manganese dioxide films was also examined as a function of the deposition time and electrolyte composition. The crystal structure and its effect on capacitive performance is also investigated.

[1] A. Cross, et al., J. Power Sources, 196 (2011) 7847-7853

[2] M.F. Dupont, et al., J. Electrochem. Soc. 160 (2013) A1219-A1231

Keywords or phrases (comma separated)

electrochemical capacitors, manganese dioxide, thin films, electrodeposition, SAXS, powder diffraction

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Session Classification: Welcome Function, Poster Session, Exhibition

Track Classification: Energy Materials