Cubic spinel \( Mn_3O_4 \) nanosheets produced by PLD of \( MnO_2 \) targets in water for supercapacitor electrodes


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In this work we report a study on the production of \( Mn_3O_4 \) nanosheets by 532 nm wavelength Nd-Yag laser ablation of a \( MnO_2 \) target immersed in deionized water. The obtained suspension was used to produce thin films on FTO substrates by electrophoresis, with the apparatus immersed in an ultrasonic bath, in order to avoid water bubbles attached to film growing surface. After deposition, the films were heat-treated at 200° C. Raman spectroscopy taken on film surface showed single phase \( Mn_3O_4 \) structure. The deposited film was observed in a Field-Emission Gun Scanning Electron Microscope (Jeol 7100 F) at high magnification (100000 times). The images showed interconnected nanosheets, and wrapped structures, in a very low-density network. Films were also prepared on C-covered Cu TEM grids, and annealed. The obtained samples were observed in High Resolution Transmission Electron Microscope (Jeol 2100 F), including convergent beam electron diffraction. There were observed very thin, well crystalized nanosheets with up to 20 nm x 15 nm size, having the \( Mn_3O_4 \) cubic spinel structure. Some of the wrapped particles were shown to be composed by pieces of well crystalized material, with different orientations. Cyclic voltametry (500 cycles) showed almost rectangular shape of the voltametric cycle, showing high stability, with slowly increasing capacitance upon number of cycles. Mass estimates considering film thickness, apparent void fraction, film area, and \( Mn_3O_4 \) density, lead to an estimated specific capacitance of about 600 F/g.