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Influence of A' cation substitution on promotion of supercapacitance of rare earth/CoO_3-based spray pyrolytic perovskite microspheres

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Considerable promotion of A' substituted $AA'BO_3$ perovskite-like structure of rare earth–CoO_3 composite supercapacitive performances is reported. The influence of cation substitution in perovskite structure on supercapacitance was also investigated. Spherical, sub-µm-sized, regular spheres of $La_{0.6}Sr_{0.4}CoO_3$ (LSCO) and $LaCoO_3$ (LCO) were synthesized by ultrasonic spray pyrolysis under different temperatures. The synthesis of Co-based oxide, namely $La_{0.6}Sr_{0.4}CoO_3$ (LSCO), was performed within single-step USP procedure. As starting precursors aqueous solutions with 0.10 M concentration of $La(NO_3)_3 \cdot 6H_2O$ (99.9% rare earth oxide), $Sr(NO_3)_2$ (99 %) and $Co(NO_3)_2$ (98%) were used for the synthesis of LSCO, and aqueous solutions with 0.10 M concentration of $La(NO_3)_3 \cdot 6H_2O$ (99.9% rare earth oxide) and $Co(NO_3)_2$ (98%) were used for synthesis of LCO. The solution for the LSCO and LCO synthesis were prepared by mixing starting precursor solutions in stoichiometric mole ratios. Synthesis temperatures were adjusted and kept to 600°C and 800°C.

LSCO and LCO composites were investigated for their supercapacitive performances in alkaline solution. Microstructure and surface morphology were studied by Scanning Electron Microscopy and X-ray Diffraction measurements. Electrochemical characterization of all LCO and LSCO samples included cyclic voltammetry (CV), galvanostatic charge-discharge (G-C/DC) and electrochemical impedance spectroscopy (EIS). The registered capacitance for LSCO reveals the promoting influence of Sr on A' position in perovskite on capacitance. The EIS analysis showed that Sr catalyzes the redox transition of Co species, with simultaneous proportional increase in capacitive abilities. This intrinsic interactive promotion introduces LSCO composite as unique supercapacitive material. Synthesis temperature plays important role on supercapacitive performances.

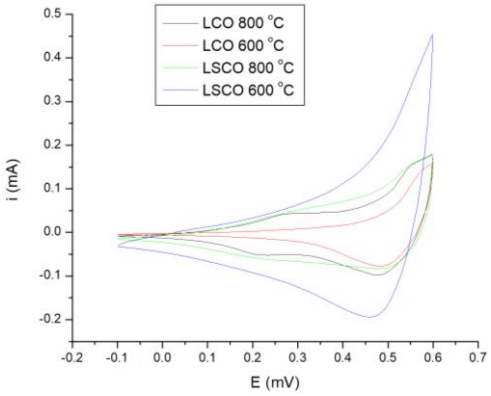

Figure 1. Cyclic voltammograms of LSCO and LCO synthetized at different temperatures at a scan rate of 50 mVs^{-1} in 0.10 M KOH; room temperature.