Low Temperature Cobalt oxide Electroxidation Synthesis

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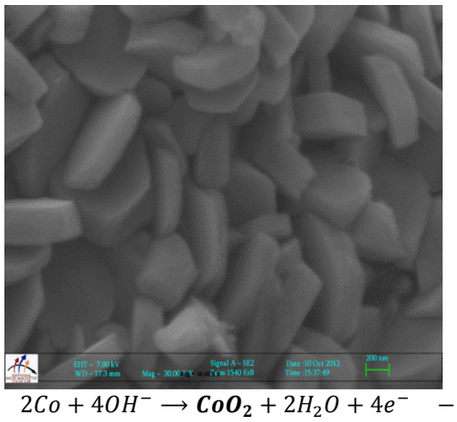
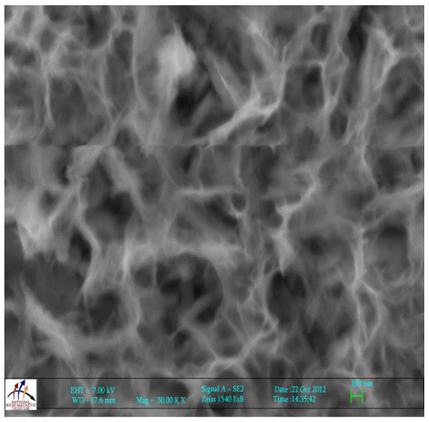
A low temperature technique for the synthesis of binder-free cobalt oxide electrocatalysts capable of use in electrochemical energy storage devices is explored. The process of identifying and choosing an oxidation potential that will theoretically produce a specific oxide phase or a mixture of phases is first determined from cyclic voltammogram. Electrocatalytic activity and other performance properties of oxide-phases produced using one-step oxidation potential will be compared to the cobalt oxides formed using two step oxidation potential schemes. Results will be presented on the performances of the different synthesized oxides in ultracapacitor and Li-based battery applications. Detailed microstructural and texture characterization of the composite oxide electrode materials and their correlation with electrochemical performance will also be presented.



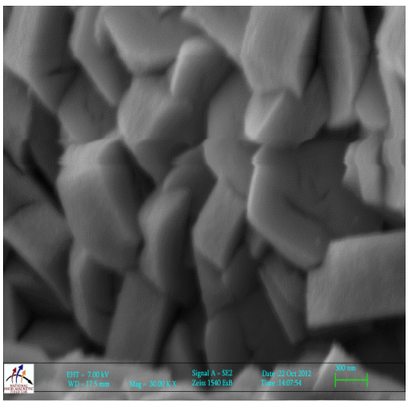
$$2Co + 4OH^- \longrightarrow \boldsymbol{CoO_2} + 2H_2O + 4e^- \quad -0.221\,V$$

Fig. 1: One-step oxide produced at -0.221V (vs. Ag/AgCl)



$$Co + 2OH^- \longrightarrow \boldsymbol{Co(OH)_2} + 2e^- \quad -0.928\,V$$
$$Co(OH)_2 + 2OH^- \longrightarrow \boldsymbol{CoO_2} + 2H_2O + 2e^- \quad +0.144\,V$$

Fig. 2: Two-step potential oxide through $Co(OH)_2$ intermediate



$$Co + 4OH^- \longrightarrow \boldsymbol{CoO_2} + 2H_2O + 4e^- \quad -0.784\,V$$

Fig. 3: One-step potential oxide produced at -0.784 V (vs. Ag.AgCl).

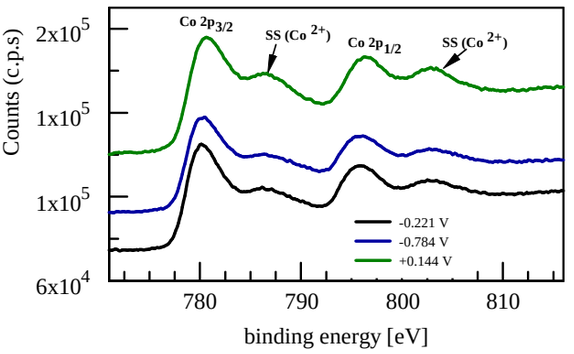


Fig. 4: XPS spectra recorded for the oxide thin films produced at different oxidation potentials