

Ferric ions substituted calcium phosphate for superior electrochemical performance: an X-ray Absorption Spectroscopic investigation

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Abstract

Currently, global warming, environmental pollution, and clean energy scarcity are major issues. It can be addressed using novel energy materials. Electrochemical energy storage candidate is one of the energy materials for rapid power density with high energy density. Recently, metal phosphates show a remarkable fascination for energy storage applications. They are structurally stable than other transition metal oxides due to their robust covalent bonding of P-O in PO₄ further, displayed excellent redox behavior. In this work, ferric ions are substituted in a calcium phosphate matrix by the co-precipitation route. Further, physicochemical, electrochemical, and electronic structures of substituted phosphates are studied. The crystallite size of substituted phosphates is reduced to 9.56 nm from 26.82 nm. The ferric ion substitution tailors morphology from rod to sphere and enhances specific capacitance (351.3 F/g at 30 mA/g) and energy density (9.41Wh/kg). XAS analysis discloses high electronic transition and reduced coordination at low ferric ions substituted sample facilitating greater electrochemical charge storage in phosphate.

Keywords- Metal Phosphate; Electrochemical charge storage; Electronic structure.