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Effects of Mn and Co Ion Implantation on Pseudocapacitive Performance of Ceria-Nanostructures on Ni-Foam

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Metal oxides have shown incredible potential as electrode materials for pseudocapacitive applications due to their high capacitance, good conductivity, electrochemical reversibility, and long cyclability. Through the engineering and manipulation of defect types and their concentrations, it is possible to enhance the kinetics of charge transfer and charge-discharge process to optimize redox and intercalation capacitances. Ion implantation is an advanced technique to uniformly introduce a desired concentration of dopants into nanostructures. The present work explores the pseudocapacitive performance of nanostructured cerium oxide (ceria, CeO2-x) films on nickel foam electrodes (synthesized using electrodeposition), followed by implantation individually with Mn and Co ions. The implanted samples were annealed in nitrogen atmosphere to promote the diffusion and incorporation of implanted dopants in the ceria lattice and to modify the nanostructural features. The films were characterised using SEM, EDS, Raman spectroscopy, and XPS analyses to determine the role of the mineralogy, composition, surface chemistry, and nanostructure on the performance. The pseudocapacitive performance was determined using cyclic voltammetry (CV), charge-discharge, electrochemical impedance spectroscopy (EIS), and stability tests. After preliminary CV testing, the Co-implanted samples (1 x 1015 ions/cm2) annealed at 300℃ for 3 h in a nitrogen atmosphere showed an improvement in specific capacitance (495 F/g) compared to the non-implanted ceria samples (427 F/g).

Level of Expertise

Student

Presenter Gender

Man

Pronouns

He/Him

Which facility did you use for your research

Centre for Accelerator Science

Students Only - Are you interested in AINSE student funding

Yes

Do you wish to take part in the Student Poster Slam

Yes

Condition of submission

Yes

Primary author(s) : Mr CHEN, Ewing Y. (UNSW)

Co-author(s) : Ms WONG, Vienna (UNSW); Mr ZHENG, Xiaoran (UNSW); Dr MOFARAH, Sajjad S. (UNSW); Dr ATANACIO, Armand J. (ANSTO); Prof. SORRELL, Charles C. (UNSW); Dr PASTUOVIC, Zeljko (ANSTO); Dr KOSHY, Pramod (UNSW)

Presenter(s) : Mr CHEN, Ewing Y. (UNSW)

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