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AP-XAS study of the reversible redox transition of SrxLa1-xCoO3-δ materials for solid oxide fuel cells

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Perovskite-type materials are being intensively investigated as cathodes for solid oxide fuel cells (SOFC) applications. The basic function of the cathode in SOFCs is to incorporate O2 from air as oxygen ions into its crystal lattice and transport them to the electrolyte through oxygen vacancy skipping mechanisms. Strontium doped lanthanum cobaltites (SrxLa1-xCoO3-δ) can undergo reversible redox transitions that involve conversion of O2 molecules into oxide ions at the material surface, followed by fast oxide ion conduction at temperatures as low as 300℃. The addition of strontium to the lanthanum cobaltite network provides cobalt ions with redox flexibility that can compensate the formation of oxygen vacancies. In addition, the inclusion of strontium to the network can induce phase transitions, from tetragonal to cubic, that can also impact vacancy generation thermodynamics. We have studied SrxLa1-xCoO3-δ for the whole 0≤x≤1 range by means of AP-XPS and AP-XAS studies and simulating the working conditions of cathodes at SOFCs by alternative cycles of oxygen dosing and vacuum annealing. We have found that
oxygen K edge XAS spectroscopy is particularly sensitive to the oxygen insertion/extraction in the perovskite network. The O K-edge spectrum exhibits a clear spectroscopic feature associated with Co4+, at approx. 528 eV, that has allowed us to study the dependency of the perovskite activity with composition. We observe better reversibility and kinetics for samples with x≤0.3, which suggests that SrxLa1-xCoO3-δ with small strontium content will be better candidates as cathodes for SOFC. Figure 1 shows the O K edge XAS for La0.1Sr0.9CoO3-δ and La0.3Sr0.7CoO3-δ thin films at 350℃ in UHV, under 100 mtorr of O2 and back in UHV as an example of a reversible and an irreversible sample.

if ”Other”, please specify:

AP-XAS Session

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No

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