Poster

Production of Apatite-like lanthanum silicate thin film electrolytes by oxidation of La-Si sputtered thin films

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The development of Intermediate Temperature Solid Oxide Fuel Cells (IT-SOFCs) requires electrolyte materials with ionic conductivity higher than the conventional yttria-stabilised zirconia (YSZ) at moderate temperatures. Lanthanum gallates (LSGM) and ceria-gadolinia (CGO) which are often cited as promising solutions present important drawbacks such as high cost of gallium and chemical instability of lanthanum gallate, and the onset of electronic conductivity in CGO under reducing environments. Recently, lanthanum silicates materials ($La_{9,33}Si_6O_{26}$) with an apatite-like structure have attracted considerable interest as potential low cost electrolyte materials. Some of these materials show conductivities comparable to, or better than, YSZ at 875 K, and are thus potential electrolytes for economic feasible fuel cells. One major drawback of these materials is that they require sintering at very high temperatures (typically >1600°C) to achieve dense materials. Using the sputtering deposition technique to produce the lanthanum silicate electrolyte allow the deposition of dense films at temperatures much lower than their bulk counterpart.

The main objective of this work is the production of apatite-like lanthanum silicates thin films by magnetron sputtering. La-Si films with the appropriate La/Si atomic ratios were deposited by magnetron sputtering from LaSi and Si targets and subsequently oxidized in controlled atmosphere to obtain the targeted lanthanum silicate oxide.

The chemical composition of the coatings was determined by electron probe microanalysis (EPMA). The structure of the coatings was studied by X-ray diffraction (XRD) using a Phillips diffractometer operated in Bragg-Brentano configuration with Co(Kα) radiation. The cross section and surface topography of the La-Si films were examined on a JEOL scanning electron microscope (SEM) equipped with an EDAX energy dispersive spectrometer (EDS). The electrical properties of the films were measured by AC impedance spectroscopy (HP4284A precision LCR meter, 20 Hz – 1 MHz).