Dielectric behavior and phase transition of $La_2Mo_2O_9$ films synthesized by spray pyrolysis technique

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ABSTRACT

The novel fast oxide ion-conducting material $La_2Mo_2O_9$ (LAMOX) thin films were synthesized by using the cost-effective chemical spray pyrolysis technique. Thermal Gravimetric and differential thermal analysis show the phase transition of $La_2Mo_2O_9$ from α-monoclinic to β-cubic phase at 546.5 °C. Rietveld refinement confirms the stabilization of the β-cubic phase for $La_2Mo_2O_9$ thin films at high temperature. The porous morphology was observed after the annealing and the XPS study revealed elements La, Mo and O observed on the surface of thin films. The temperature and frequency-dependent dielectric constant were studied using an LCR-Q meter in the frequency range of 20 Hz–300 kHz. As the frequency increases, the dielectric constant and dielectric loss decreases for all $La_2Mo_2O_9$ thin films. The dielectric constant, dielectric loss and AC conductivity varied with increasing temperature, shows two relaxation peaks indicating the presence of oxide ion vacancies for ion conduction. The complex impedance shows the Cole–Cole plot for the LAMOX thin films.

1 Introduction

A fuel cell is an electrochemical device that converts chemical energy directly into electrical energy with the water as a by-product [1, 2]. The oxide ion-conducting materials are the interesting materials because of its application mainly in fields like oxygen sensors, oxygen pumps, oxygen separation membranes and solid oxide fuel cells [3–8]. In 2000, Lacorre [5] discovered the new fast oxide ion-conducting material and illustrated that the lanthanum molybdenum oxide ($La_2Mo_2O_9$) possesses greater ion conduction ability at 800 °C than the conventional oxide ion conductor Yttria Stabilized Zirconia (YSZ). The phase transition of $La_2Mo_2O_9$ takes place from low oxide ion conducting α-monoclinic to high oxide

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