Effect of Volume of Solution on Structural & Morphological Properties of $La_2Mo_2O_9$ Thin Films

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Abstract: The $La_2Mo_2O_9$ (LAMOX) material used as electrolyte in Solid oxide fuel cell (SOFC), LAMOX thin films were fabricated using the chemical spray pyrolysis method during the deposition at constant temperature of 350 °C varies the volume of solution 20 ml, 30 ml, 40 ml and 50 ml and studies the effect of temperature on deposited substrate by annealed it at 1000 °C for two hours. X-ray diffraction analysis revealed a transition from the monoclinic phase to the cubic phase following the annealing of the LAMOX thin film. Morphological investigations were carried out through SEM analysis, indicating an increase in grain size post-annealing. The FTIR study revealed the bond stretching present in the prepared material gives the evidence of precursor were used during the deposition.

Keywords: ***SOFC, electrolyte, SEM, XRD etc.***

I. Introduction

The device used to convert chemical energy in to the electrical energy and water as by product such device is called as solid oxide fuel cell. Since the discovery of the $La_2Mo_2O_9$ (LAMOX) material, it has become integral to the advancement of solid oxide fuel cell (SOFC) technology, serving as an electrolyte due to its oxide ion conductivity at intermediate temperatures [1-3]. A critical aspect influencing electrolyte performance is its oxygen ion conductivity. Prior to the emergence of LAMOX, Yttria Stabilized Zirconia (YSZ) was commonly utilized as an electrolyte, exhibiting a commendable ionic conductivity of 0.1 S cm-1 at 1000 ^{o}C [4]. However, YSZ necessitates expensive interconnects and contributes to cell ohmic loss, consequently inflating fuel cell costs. In 2000, Lacorre et al [5] uncovered the LAMOX family of oxygen ion conductors, with its functionality rooted in the concept of lone pair substitution (LPS) [6]. LAMOX demonstrates superior oxygen ion conduction capabilities compared to YSZ at intermediate temperatures [5]. The first synthesis of the $La_2Mo_2O_9$ compound was achieved by Fournier et al in 1970 [7], with the compound undergoing a phase transition from monoclinic to cubic phase at approximately 580 °C [8-10]. Fast oxide-ion conductors hold promise for various applications including SOFCs, oxygen sensors, and oxygen pumping devices [11-16]. The effect of deposition parameters volume of spray solution on structural and morphological properties of LAMOX thin films are discussed in this paper.

II. Experimental

The spray pyrolysis method was utilized to deposit thin films of LAMOX on alumina (Al_2O_3) and glass substrates. Analytical grade chemicals, specifically lanthanum chloride ($LaCl_3$ $7H_2O$) and molybdic acid (MoO_3 H_2O), were directly employed for the synthesis of these films without additional treatment. The synthesis involved using the two precursors in appropriate molar concentration ratios. Lanthanum chloride