EFFECT OF SYNTHESIS METHOD ON PHASE FORMATION AND HIGH-TEMPERATUREPHASE TRANSITION IN La_2 Mo_2O_9

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Oxygen-ion-conducting solid electrolytes have been investigated for over six decades due to their potential applications in galvanic cells for precise thermodynamic and kinetic measurements of oxygen-containing systems, oxygen sensors for gaseous and liquid-metal environments, and high-temperature fuel cells [1]. However, their practical relevance to energy conversion technologies has become particularly significant only in recent years [2]. Conventional solid electrolytes, such as yttria-stabilized zirconia (YSZ), exhibit optimal ionic conductivity at high operating temperatures (800 °C – 1000 °C) [3], while gadolinium-doped ceria operates at lower temperatures (600 °C – 800 °C) but suffers from mixed ionic–electronic conductivity and reduced stability under reducing conditions [4]. In this context, lanthanum molybdate ($La_2Mo_2O_9$), commonly referred to as LAMOX, has emerged as a promising alternative, owing to its exceptionally high oxygen-ion conductivity at elevated temperatures, first reported by Lacorre et al. in 2000 [5]. Nevertheless, the principal limitation of this binary oxide system arises from a reversible phase transition occurring in the 500 – 600 °C temperature range, during which the low-temperature monoclinic α-$La_2Mo_2O_9$ phase transforms into the high-temperature cubic modification responsible for enhanced oxygen-ion transport [6]. The complexity of the lanthanum molybdate system, along with its strong temperature dependence of physical properties, motivated this study to examine the influence of the final ceramic composition on the thermal effect associated with the phase transition, which is directly related to the physical properties of the cubic $La_2Mo_2O_9$ crystalline phase. X-ray diffraction (XRD) and thermogravimetric/differential scanning calorimetry (TGA/DSC) analyses were employed to evaluate the phase composition of the synthesized ceramic materials and the energetic characteristics of the high-temperature phase transition.

The results clearly indicate that both the initial molar composition and the used synthesis method have a strong influence on the final crystalline phase composition, as well as on the intensity of the phase transition thermal effect and the physical properties of the obtained ceramics at elevated temperatures.

Keywords: Sol-gel synthesis · Solid-state reaction · Phase transition · Thermal analysis · X-ray diffraction

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