SYNTHESIS AND CHARACTERIZATION OF $La_2Mo_2O_9$ SOLID OXIDE-ION CONDUCTOR PREPARED BY AN AQUEOUS SOL-GEL METHOD

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Fuel cells were discovered by William Grove in early 1839. The basic operating principle of these devices is to generate electricity and heat from hydrogen and oxygen as long as fuel and oxidant are supplied [1]. Comparing these devices with other conventional and distributed generation systems it was observed that the energy efficiency of fuel cells is always higher and pollution emissions are much lower [2]. Solid-oxide fuel cells (SOFCs) are one of the most environmentally friendly and efficient technologies to produce electric power and heat [3, 4]. Nowadays, the most widely used materials for a SOFC electrolyte are yttria-stabilized zirconia (YSZ) and gadolinium-doped ceria (GDC). However, these materials require a high-operating temperature (1000 °C) to obtain high oxide-ion conductivity. In 2000, Lacorre et al. discovered a new family of oxide ion conductors with parent compound $La_2Mo_2O_9$ [5]. Lanthanum molybdate undergoes a reversible transition from monoclinic α-phase to cubic β-phase structure at 580 °C, leading to an increase in the ionic conductivity up to two orders of magnitude and reaching values higher than those corresponding to YSZ [6].

Currently, there are various ways to synthesize LAMOX compounds, and it is known that the thermal decomposition mechanism and phase transition strongly depends on the preparation method. Lanthanum molybdate ceramic synthesized by such methods as solid-state route, citrate, a Pechini, the microwave-assisted, and EDTA complexation methods usually contain impurities, and the obtained compound has a porous structure. To eliminate these drawbacks, a lot of attention has been drawn to wet-chemical methods. The simplest, cheapest and most environmentally friendly method is an aqueous sol-gel synthesis, which creates an opportunity to control the final ceramic structure, crystallites size and morphology.

In this paper, the aqueous sol-gel synthesis was successfully used to synthesize homogenous La–Mo–O tartrate gel for $La_2Mo_2O_9$ ceramic. Tartaric acid that has two carboxylate and two hydroxyl groups, is used in this method as a complexing agent, which reduces interaction between individual components by leading to avoidance of impurities and inhomogeneity of the final ceramics. The thermal decomposition mechanism of the as-prepared La–Mo–O gel precursor was investigated by the thermogravimetric and differential scanning calorimetric (TGA/DSC) analysis. Moreover, the DCS technique was successfully applied for the measurement of enthalpy for phase transition from α-phase to β-phase in the $La_2Mo_2O_9$ system. The structure and surface morphological features of the heat-treated ceramic powders were additionally studied by X-ray diffraction (XRD) and scanning electron microscopy (SEM) analysis methods.

References

1. G. Hoogers. Fuel Cell Technology Handbook: VRV press, 2002.
2. A. Kirubakaran, S. Jains, R. Nema. Renew. Sustain. Energy Rev. **15 (**2011) 4507.
3. A. Choundhury, H. Chandra, A. Arora. Renew. Sustain. Energy Rev. **20 (**2013) 430.
4. N. Laosiripojana, W. Wijuratn, W. Kiatkittipong, A. Arpornwichanop, A. Soottitantawat, S. Assabumrungrat. Eng. J. **13** (2009) 65.
5. P. Lacorre, F. Goutenoire. Nature, **404** (2000) 856.
6. X. Liu, HQ Fan, Q. Li, J. Shi. Ecs Solid State Lett. **2(9)** (2013) N27.