**PARTIAL ELECTRONIC CONDUCTIVITY OF Sr AND Mg DOPED $LaGaO_3$**

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**ABSTRACT**

The application of solid oxide electrolytes includes solid oxide fuel cell (SOFC), oxygen probes or sensors, gas-separating membranes etc. [1]. A typical solid oxide electrolyte is a stabilized zirconia with cubic fluorite structure to which doped $CeO_2$ and $ThO_2$ also belong. Ever since the introduction of a new perovskite-structured solid oxide electrolyte, the Sr and Mg doped $LaGaO_3$ (LSGM) has attracted great interest of researchers who are in search of the solid electrolytes for the intermediate temperature SOFC [2].

In spite of the promising aspects of LSGM, this material has several drawbacks, such as the high cost of gallium oxide, relatively weak mechanical strength [3, 4] and the chemical stability problem under highly reducing conditions at high temperatures [5, 6]. Another possible problem is a non-negligible partial electronic conductivity.

Although other authors also have reported the electronic conductivities of LSGM [6-8], the basic information such as the activation energy, thermal band-gap energy and the effects of composition on the electronic conduction properties is still lacking. The main object of this study is to examine the effect of the acceptor concentration on the partial electronic conductivity of LSGM. The ion-blocking Hebb-Wagner polarization method was employed.[9]

The partial electronic conductivities ($\sigma_{el}$) of $La_{0.9}Sr_{0.1}Ga_{0.9}Mg_{0.1}O_{2.90}$ (LSGM9191) (Fig.1), $La_{0.9}Sr_{0.1}Ga_{0.8}Mg_{0.2}O_{2.85}$ (LSGM9182) and $La_{0.8}Sr_{0.2}Ga_{0.8}Mg_{0.2}O_{2.80}$ (LSGM8282) were measured by Hebb-Wagner ion-blocking method between 700 and 900°C. As the Sr and Mg content increased, both the hole and the electron conductivity decreased together with the increased activation energy of conduction. (Fig.2) The electronic transference numbers of the three compositions were approximately $10^{-2}$~$10^{-3}$, much larger than that of zirconia. From the Hebb-Wagner curves, the variation of $\sigma_{el}$ was obtained as a function of oxygen partial pressure ($Po_2$). The thermal band-gap energy ($E_g$) values were estimated from the conductivity minima and were 2.35eV, 2.89eV and 4.28eV for LSGM9191, LSGM9182 and LSGM8282, respectively, increasing with acceptor concentration. However they were much smaller than that of yttria-stabilized zirconia (YSZ).

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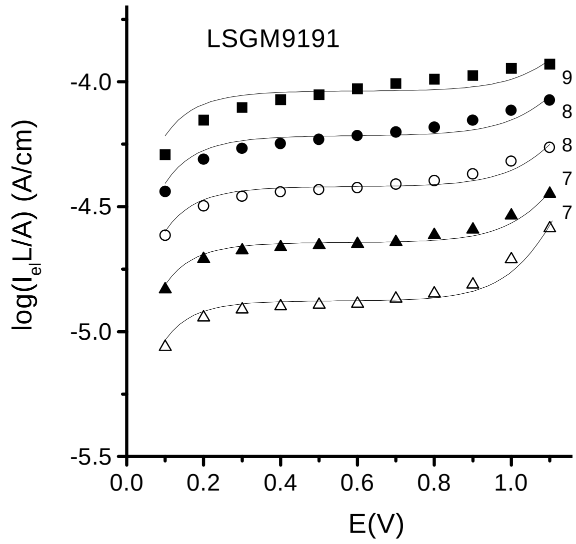


Fig.1 Hebb-Wagner curves of LSGM9191 sample varying with temperatures between 700 and 900°C. Air was used as the reference $Po_2$. The y-axis was modified to accommodate the difference in the sample dimension.

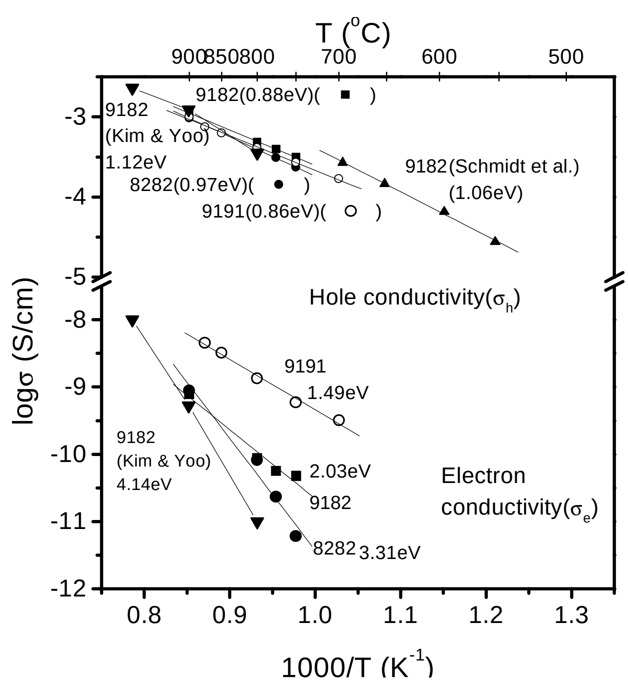


Fig.2 The hole ($\sigma_h$) and electron ($\sigma_e$) conductivities of the three LSGM compositions in air. Sample compositions and their activation energies are shown.