§2. Hydrogen Isotope Recovery by Use of Proton Conductor Steam Electrolysis Performed at High Temperature

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1. Introduction

Perovskite-type oxides (ABO3) show proton conduction as a result of partial substitution of part of the constituent metal (A and B) with a lower-valent cation dopant. Also, the suitable operating temperature for solid state proton conducting electrolytes is 600 ^{o}C. Proton conductor can be used for hydrogen pumps, detector (sensor) and steam electrolyzers because of the mobile hydrogen ion. Therefore, we consider steam electrolysis using proton conducting oxide as a method of efficient hydrogen isotope separation in a nuclear fusion reactor. The transition metal (e.g. Co, Fe, Mn and Ni) containing oxides are commonly used as electrode. If transition metal will diffuse to electrolytes, there is a concern that the diffused transition metals will degrade the electrolyte performance. In this study, the transition metal doping has been performed and their electrical properties were investigated for anode side of oxidizing atmosphere. The electrode side of occurring hydrogen is commonly used as Ni. Therefore, we examined the electrical conductivity changes in hydrogen atmosphere.

2. Experimental

$AB_{0.85}Y_{0.1}M_{0.05}O_{3-\delta}$ (A = Ba, Sr; B = Ce; M = Y, Ni, Fe, Mn) were prepared by chemical solution method. The sintered samples exhibit perovskite structure by X-ray diffraction. The electrical conductivity was measured by a four-terminal AC impedance method by bar type samples.

3 . Result and discussion

Fig.1 shows the temperature dependence of the Electric conductivity of transition metal doped SCY and BCY. The black solid line represents the conductivity values of the original electrolytes. (undoped SCY and BCY) According to the plots the electrical conductivity of SCY base electrolytes, almost same or slightly increase (Mn) with the introduction of transition metals. Meanwhile, transition metals doped BCY show a half order (Ni and Mn) and one order (Fe) of magnitude decrease in conductivity, respectively. According to these results, the effect of transition metals influence for electrolyte is little in anode side.

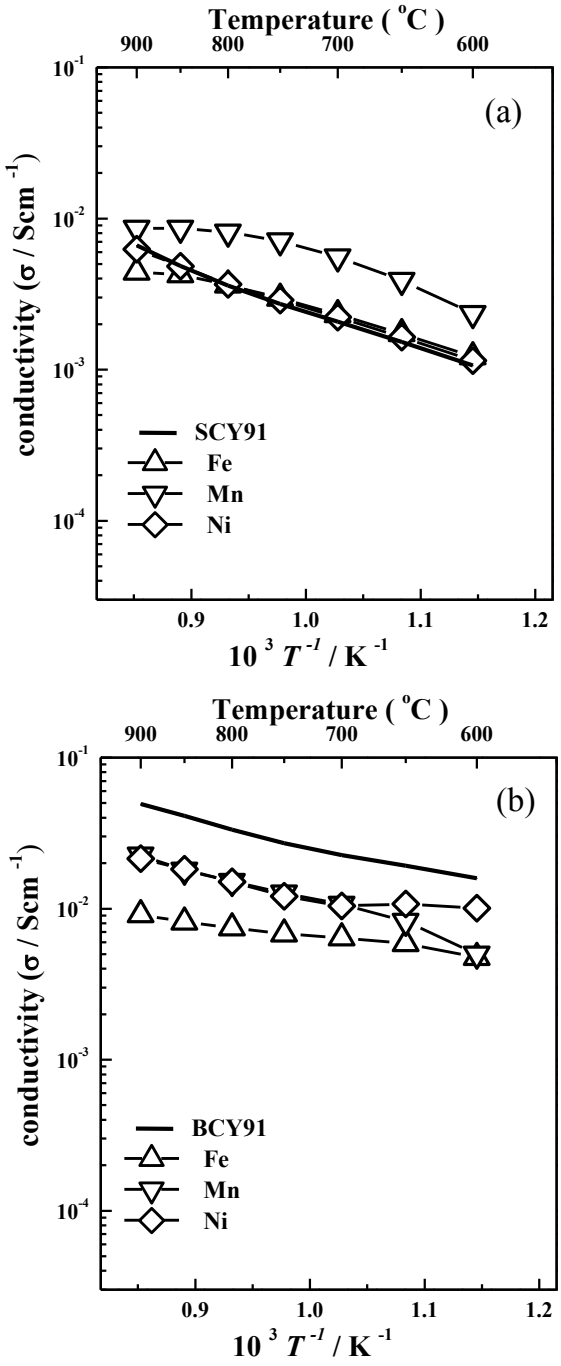

Fig. 1 The temperature dependence of the electric conductivity of (a) $SrCe_{0.85}Y_{0.1}M_{0.05}O_{3-\delta}$ and (b) $BaCe_{0.85}Y_{0.1}M_{0.05}O_{3-\delta}$ (M=Y, Fe, Mn, Ni) in moist 1% H2 atmosphere (p_{H2O} = 1.9 kPa)