CHARGE CARRIER MAPS FOR $(La_{0.9}Sr_{0.1})M^{III}O_{3-\delta}$ (M^{III} = Sc and In) PEROVSKITES AND $(Ce_{0.8}Sm_{0.2})O_{2-\delta}$ FLUORITE

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Total electrical conductivities, σ_t, (= oxide ion conductivity (σ_{O2-}), proton conductivity (σ_{H+}), hole conductivity (σ_{h+}), plus electronic conductivity (σ_{e-})) were measured for $(La_{0.9}Sr_{0.1})M^{III}O_{3-\delta}$ (M^{III} = Sc and In) perovskite-type oxides and $(Ce_{0.8}Sm_{0.2})O_{2-\delta}$ fluorite-type one under different temperatures, *T*, oxygen partial pressures, $P(O_2)$, and hydrogen partial pressures, $P(H_2)$. The conductivity data obtained were analyzed on the basis of a defect equilibrium model, and the results have been depicted uniformly as "charge carrier maps" which show predominant charge carrier (i.e., oxide ion (O^{2-}), proton (H^+), hole (h^+), and electron (e^-)) domains as functions of *T*, $P(O_2)$, and $P(H_2)$ [1].

$(La_{0.9}Sr_{0.1})ScO_{3-\delta}$ perovskite (LSS) showed the O^{2-}, H^+, and h^+ conduction domains (see Fig. 1). The horizontal lines show the $P(O_2)$ values where $\sigma_{h+} = \sigma_{O2-}$. The vertical lines the $P(H_2)$ where $\sigma_{h+} = \sigma_{H+}$. The oblique lines the $P(H_2O)$ where $\sigma_{O2-} = \sigma_{H+}$. The dotted oblique lines the $P(H_2O)$ at 1000ºC. Under an anode condition, e.g., at 1000ºC, $P(H_2)$ = 1 atm, and $P(H_2O)$ = 0.1 atm (depicted as a closed circle in Fig. 1), the LSS is expected to work as a predominant proton conductor.

$(La_{0.9}Sr_{0.1})InO_{3-\delta}$ perovskite (LSI) showed the O^{2-}, H^+, and h^+ conduction domains (see Fig. 2). The lines drawn in Fig.2 have the same meaning as those in Fig. 1. The LSI decomposed at $P(O_2) < 10^{-15}$ atm and $P(H_2) > 10^{-2}$ atm domain. Under an moderate anode condition, e.g., at 1000ºC, $P(H_2) = 10^{-3}$ atm, and $P(H_2O) = 10^{-2}$ atm (a closed circle in Fig. 2), the LSI is expected to be a predominant oxide ion conductor.

$(Ce_{0.8}Sm_{0.2})O_{2-\delta}$ fluorite (SDC) showed the O^{2-} and e^- conduction domains (Fig. 3). The horizontal lines show the $P(O_2)$ values where $\sigma_{O2-} = \sigma_{e-}$. The dotted oblique lines the $P(H_2O)$ at 700ºC. Under an anode condition, e.g., at 700ºC, $P(H_2) = 10^{-2}$ atm, and $P(H_2O)$ = 0.042 atm (a closed circle in Fig. 3), the SDC is expected to work as a mixed ($\sigma_{O2-} \approx \sigma_{e-}$) conductor.

The "charge carrier maps" can be used to predict the electrical conduction properties of the electrolyte materials for solid oxide fuel cells (SOFCs) under different operating conditions.

ACKNOWLEDGMENTS

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REFERENCE

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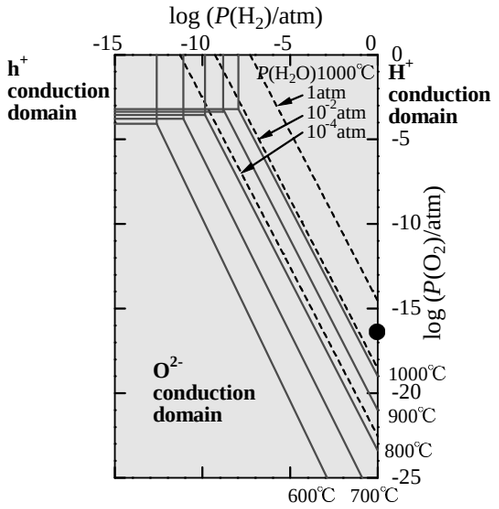

Fig. 1 Charge carrier map for $(La_{0.9}Sr_{0.1})ScO_{3-\delta}$ perovskite (LSS) between 600 and 1000˚C (predominant oxide ion, proton, and hole conduction domains are shown).

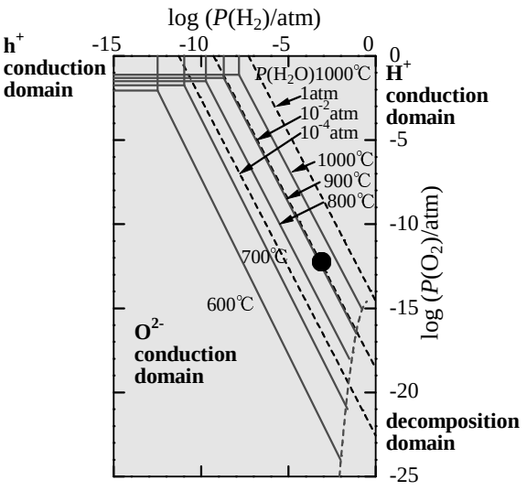

Fig. 2 Charge carrier map for $(La_{0.9}Sr_{0.1})InO_{3-\delta}$ perovskite (LSI) between 600 and 1000˚C (predominant oxide ion, proton, and hole conduction domains are shown).

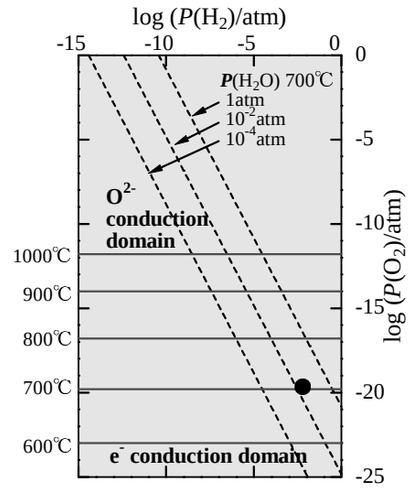

Fig. 3 Charge carrier map for $(Ce_{0.8}Sm_{0.2})O_{2-\delta}$ fluorite (SDC) between 600 and 1000˚C (predominant oxide ion and electronic conduction domains are

shown).