

Proton Conducting Ceramics for Hydrogen Production; addressing the effects of dopant levels and
proton content in BZCY and SZCY systems

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Hydrogen is an attractive energy carriers and it is widely believed that its affordable production and application are prerequisites for the timely adoption of a hydrogen economy. Nowadays interest in environmentally friendly technologies has elevated research on greenhouse gas emission-free devices. Hydrogen produced by steam electrolysis taking advantage of sustainable energy sources and using proton conducting ceramics as electrolytes materials appear promising. However prior to a successful industrial application, it is necessary to properly understand the complex chemical behavior especially that related to proton content and the undesirable properties of some key materials.

In the present work, we examined the proton content by tailoring dopant concentration or/and the change of A-site cation from Sr to Ba, to improve the conductivity of $\text{SrZr}_{0.5}\text{Ce}_{0.4}\text{Y}_{0.1}\text{O}_{3-\delta}$ (SZCY-541). Yttrium is selected as the dopant because of the high proton conductivity this species imparts, presumably as a result of its good ionic radius match to Zr. Ba at A-site provides higher proton mobility than Sr. BZCY-(54)_{8/92} (BZCY542) shows higher conductivity than BZCY-541 in response to the increase in Y dopant, figure 1. Whereas, SZCY-541 and SZCY-(54)_{8/92}, showed almost comparable conductivity both in hydrogen and oxygen atmospheres, suggesting Ba and Sr have different effect on the degree of hydration. This paper discusses these aspects based on experimental results as well as steam electrolysis using SZCY-541 and BZCY542 as electrolytes. Electrolysis voltage as low as 1.5 V was attained for a current density of $0.5\text{A}/\text{cm}^2$ at 600°C , Using 1 % H_2 and 1 % O_2 as cathode and anode gases respectively. BZCY542 was more effective in reducing overvoltage than SZCY541.

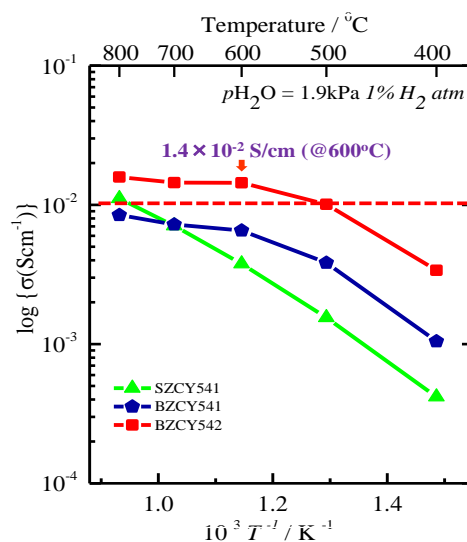


Figure 1. Arrhenius plot of proton conductivity in BZCY and SZCY