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Editorial

Special Issue on Promising Materials and Technologies for Solid Oxide Electrochemical Devices

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Solid oxide electrochemical devices, such as fuel cells, electrolyzers, pumps, sensors, etc., have become increasingly important for providing novel solutions to green energy, as well as environmental and healthcare issues. Solid oxide fuel cells are promising devices for clean energy production by converting the chemical energy of a fuel source into electricity. Solid oxide electrolysis is an effective technology for the production of green hydrogen, which is currently considered the fuel of the future. Oxygen-pumping technologies have great potential for application in healthcare, especially in the context of the COVID-19 pandemic. Valid and reliable solid oxide sensors are strongly needed for environmental monitoring.

This Special Issue is aimed to cover the recent advances and new trends in the development of materials and technologies for solid oxide electrochemical cells; their processing and performance; the design, fabrication, and testing of the cells; and the related activities in the field of solid oxide electrochemical devices.

A total of five research papers in this field of research concerning new functional materials and the development of solid oxide electrochemical cells are presented in this Special Issue. Belova et al. [1] reported on the crystal structure, electrical conductivity, and hydration ability of novel proton-conducting electrolytes with perovskite structures, namely Mg- and Ca-doped $La_2ScZnO_{5.5}$. Doping was shown to enhance the ionic conductivity of the perovskites; the $La_2Sc_{0.9}Ca_{0.1}ZnO_{5.45}$ sample demonstrated the highest conductivity and has great promise to be used as a proton-conducting membrane in protonic solid oxide electrochemical cells. Tarasova et al. [2] reported on the protonic transport in perovskite-like oxides with the Ruddlesden–Popper structure: $BaLa_nIn_nO_{3n+1}$ (n = 1, 2). Parameter n was found to significantly influence the ionic conductivity: A better performance was demonstrated by the composition with n = 2, which possessed nearly pure protonic conductivity in humidified air at temperatures below 350 °C. Shlyakhtina et al. [3] reported on the electrical conductivity of new pyrochlore-type oxides, namely $La_2(Hf_{2-x}La_x)O_{7-x/2}$ (x = 0, 0.1), and demonstrated that modifying the hafnate with excess lanthanum improves its ionic (oxide-ion and protonic) conductivity. Maksimchuk et al. [4] presented a comprehensive study of electrode materials, namely $Nd_{1.6}Ca_{0.4}Ni_{1-y}Cu_yO_{4+\delta}$ (y = 0–0.4), including the refinement of their crystal structure, thermal and chemical stability, thermal expansion properties, oxygen diffusion, and electrochemical performance in contact with a number of oxide-ion and proton-conducting electrolytes; the composition with y = 0.2 was found to be a promising electrode material for the solid oxide fuel cells operating at the intermediate temperatures. Kalyakin et al. [5] designed a dual-chamber amperometric sensor based on the YSZ (ZrO_2 + 8 mol% Y_2O_3) electrolyte for the simultaneous measurement of CO and CO_2 concentrations in inert gases, which can be used for atmosphere control in food packaging, preservation, and storage systems in the pharmaceutical and chemical industries.

Although submissions for this Special Issue have been closed, the research activity in the development of solid oxide electrochemical devices remains at a high level, and researchers constantly contribute to providing novel solutions to the current challenges in this field.

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