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# Structural and electrochemical studies of multi-ion conductors for low temperature solid oxide fuel cells

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## Abstract

Novel electrolyte materials of compositions $Ca_{0.1}Sm_{0.1}Ce_{0.8}O_2$–δ-$Y_2O_3$, $Ba_{0.1}Sr_{0.1}Ce_{0.8}O_2$–δ-$Y_2O_3$, and $Ba_{0.1}Sm_{0.1}Ce_{0.8}O_2$–δ-$Y_2O_3$ for oxide, protonic and hybrid ions conduction respectively, have been synthesized via cost effective co-precipitation technique. The effect of multi ions conduction to enhance the ionic conductivity is observed. Electrochemical properties have been investigated by fuel cell performance and DC 4-probe method in air and hydrogen atmosphere. Structure, morphology and absorption spectrum are characterized by X-Ray diffraction (XRD), scanning electron microscopy (SEM) and Fourier Transformation Infrared Spectroscopy (FTIR) respectively. Average crystallite size is calculated in the range of 27 to 98 nm by XRD. The multi-ion conductivities are obtained using Hebb-Wagner blocking layer method and found that the materials $Ca_{0.1}Sm_{0.1}Ce_{0.8}O_2$–δ-$Y_2O_3$, $Ba_{0.1}Sr_{0.1}Ce_{0.8}O_2$–δ-Y2O3, and $Ba_{0.1}Sm_{0.1}Ce_{0.8}O_2$–δ-$Y_2O_3$ have conductivities 0.142, 0.083, and 0.193 Scm-1 for oxide, protonic, and hybrid ion $O_2$-, H+, respectively at 600oC. Power densities have been achieved 460, 608, and 752 mWcm-2 for protonic, oxide ions, and hybrid ions conductor, respectively at 600oC using hydrogen fuel. The water vapors appearance at both sides verifies the hybrid ions conduction in $Ba_{0.1}Sm_{0.1}Ce_{0.8}O_2$–δ-$Y_2O_3$ electrolyte material. The obtained results of $Ba_{0.1}Sm_{0.1}Ce_{0.8}O_2$–δ-$Y_2O_3$ electrolyte material are encouraging to use hybrid ion material in solid oxide fuel cell.

The development of nanocomposite functional electrolyte materials with higher power density, good working efficacy is of much importance in solid oxide fuel cell.

## Biography

Zohaib Ur Rehman has completed his master of science in physics at the age of 25 years from COMSATS University Islamabad, Lahore campus Pakistan. He is researcher at COMSTAS University. He has published eight research articles in different peer-reviewed and well reputed international journals. His cumulative impact factor is more than 25. He worked on “Advance Renewable Energy Conversion and Storage Devices” (especially fuel cells, batteries, and supercapacitors).

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