Molten Salt Synthesis and Characterization Studies of co-doped Ceria Electrolytes for IT-SOFCs

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ABSTRACT

Solid oxide fuel cells (SOFC) have attracted extensive attention due to their high-energy conversion efficiency, fuel flexibility and environment safety. Yttria stabilized zirconia (YSZ) solid electrolytes have been extensively investigated for SOFCs because of their high ionic conductivity and chemical stability in reducing anodes and oxidizing cathode atmospheres. But it requires high operating temperature (~1000°C) to gain high enough conductivity which limits the selection of component material for SOFC. Lowering the operating temperature would increase the lifetime of the cell, SOFC stability, widen the selection of the electrodes, interconnect and other construction materials which reduce the overall cost of the fabrication of SOFC system. Doped CeO_2 based solid electrolyte exhibits high ionic conductivity than the conventional YSZ at intermediate temperature (600-800°C). Rare earth doped ceria exhibit good ionic conductivity in the intermediate temperature region. One of the approaches to further improve the ionic conductivity and other properties is to dope ceria with two or more components (co-doping). Many methods have been developed for the synthesis of nanocrystalline doped ceria systems. In this work, we are going to present a low temperature synthesis of nanostructured system of co-doped ceria ($Ce_{0.8}Gd_{0.1}Nd_{0.1}O_{2-\delta}$) doped with transition metal elements like (Cu and Co) via a facile and environmental friendly molten salt method. Hydrated metal nitrates and sodium hydroxide are used as the raw materials. The proposed procedure consists of a mechanically induced metathesis reaction and short firing above the melting point of sodium nitrate. The purpose of mechanically induced metathesis reaction is to generate in situ $NaNO_3$ flux and to obtain a suitable precursor for the synthesis of target materials in molten nitrates. The prepared materials were then characterized by X-ray diffraction, thermal analysis, infra-red analysis, transmission electron microscopy, electrical properties etc.

Keywords: solid oxide fuel cells, ionic conductivity, molten salt synthesis