Effects of preparation methods on producing alternative electrolyte materials for IT-SOFCs

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Due to the degradation of state-of-the-art electrolyte materials from operation of SOFCs at high temperatures, research is focused to materials with high ionic conductivity and structural integrity at intermediate temperatures. Apatite-Type Lanthanum Silicates (ATLS) are promising electrolytes at IT-SOFCs as their ionic conductivity increases with doping sustaining their structural integrity [1-6]. The ATLS of general formula $La_{9.83}Si_{6-x-y}Al_xFe_yO_{26\pm\delta}$ were synthesized with mechanochemical activation (MA), sol-gel (SG) and solid state methods. Stoichiometric amounts were properly mixed for each method and the powders of each material prepared via the MA, SG and SSR methods were pressed into pellets (disks). Sintering was performed in air with temperatures up to 1600 °C and dense pellets were achieved (>95%) via uniaxial pressing and verified by archimedes method. The prepared materials were characterized using X-rays diffraction, particle size analysis by light scattering and thermal analysis (TG-DTA) [7-10]. The microstructure was observed by SEM and TEM. Conductivity measurements were performed in air at 600 to 850 ^{o}C. An investigation of interaction with a state of the art interconnector material CROFER-22 was also investigated in order to provide evidence of chemical compatibility for potential use in IT-SOFCs. All preparation methods provided materials with apatite structure. Mechanochemical activation technique in high energy planetary ball mills provides single–phase samples of Al or Fe–doped lanthanum silicates. The doped apatite type of materials showed significant conductivity in medium temperatures (600-800 ^{o}C) and the presence of Fe in the apatite samples seems to enhance Cr incorporation.

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