

Electrical properties of zircon ceramics doped with yttria

The broad aim of this work is to explore the possibility of developing zircon ($ZrSiO_4$) based materials as cathode/electrolyte materials in fuel cells. In general, fuel cells are electrochemical devices that convert chemical energy into electrical energy via electrochemical reactions. The electrolyte of the present solid oxide fuel cells is based on zirconia (ZrO_2) ceramics. Zircon (Zircon ($ZrSiO_4$)) is a less expensive chemical compared to ZrO_2 , and is freely available in the coastal areas of Sri Lanka in the form of sand. The electrical properties of zircon with different yttria (Y_2O_3) dopant concentrations (5-20 mol%) have been examined as a function of temperature.

It was observed that there was a significant dependence of conductivity and dielectric property of zircon ceramics on temperature and composition. 10mol% Y_2O_3 doped zircon showed the highest conductivity ($7.74 \times 10^{-5} \text{ Scm}^{-1}$ at 700°C) with a low activation energy (0.37eV) and a higher dielectric constant (409 at 700°C). The conductivity of undoped zircon was about one order of magnitude lower than that of 10 mol% Y_2O_3

doped zircon ($3.82 \times 10^{-6} \text{ Scm}^{-1}$ at 700 C°) with a higher activation energy (0.78 eV). The dielectric constant of undoped zircon was found to be 64 at 700 C . Electrical conductivity increased with increasing Y_2O_3 content up to 10 mol% and decreased with further addition of Y_2O_3 content. The other compositions had almost similar activation energy values. These values are almost comparable with those of ZrO_2 . The existence of a mixed electronic and ionic conduction in Y_2O_3 doped zircon ceramics was evident from the d.c polarisation tests. The average electronic transference number was 0.45 for 10mol% Y_2O_3 doped zircon and it was more than 0.75 for the other dopant concentrations.