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$ZrO_2:In_2O_3$ Solid Electrolytes

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Abstract – Doped ZrO_2 solid electrolytes shows high ionic conductivity at high temperatures in the cubic phase. In this work, ZrO_2: x mol % In_2O_3 (x= 6, 8, 10 and 12) powders were prepared by solid state reaction and studied by X ray powder diffraction, thermogravimetry, differential thermal analysis, and electrochemical impedance spectroscopy. The preliminary results show the stabilization of india doped zirconia at low temperatures with low In_2O_3.

The polymorphic nature of zirconia is well known. Zirconium oxide has at least three crystallographic phases at atmospheric pressure: fluorite-type cubic from its melting point (~ 2680 °C) down to ~ 2370 °C, tetragonal from that temperature to ~ 1150 °C, and monoclinic for lower temperatures. After forming solid solution with aliovalent oxides (CaO, MgO, and Y_2O_3), the fluorite cubic structure is also detected at temperatures where pure zirconium oxide is monoclinic [1]. The zirconium oxide is then considered stabilized: the cubic phase that is stable in the pure oxide at high temperatures may now be found at room temperature due to solid solution formation after reaction with the aliovalent oxides. The extent of stabilization depends on the amount of the chosen stabilizer and can be determined from both the binary phase diagram of the stabilizer oxide–zirconium oxide or X ray diffraction analyses [1]. The cubic ZrO_2 phase doped with In_2O_3 shows ionic conductivity values comparable to those obtained from cubic Y_2O_3 stabilized ZrO_2 [2]. In this work ZrO_2:x mol %In_2O_3 (x= 6, 8, 10 and 12) were obtained by a solid state reaction and by a nitrate thermal decomposition route. The obtained materials were studied by X ray powder diffraction, thermogravimetry, differential thermal analysis, and electrochemical impedance spectroscopy.

Figure 1 shows the X ray powder diffraction of ZrO_2:8 mol %In_2O_3, showing a mixture of tetragonal and cubic phase stabilized after low temperature thermal treatment (500 ^oC/1h). Figure 2 shows the thermogravimetry/differential thermal analysis of ZrO_2:8 mol%In_2O_3 obtained by a nitrate decomposition route. The heat flow curve shows five exothermic peaks which can be attributed to the complete nitrate decomposition up to 500 ^oC. The preliminary results show the stabilization of india doped zirconia at low temperatures with low In_2O_3.

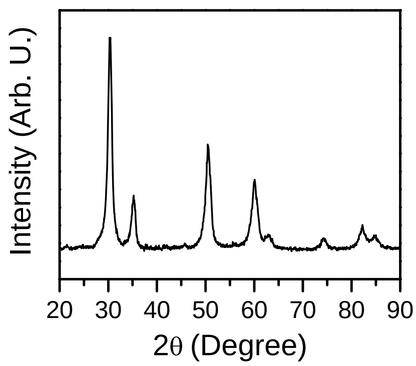

Figure 1: X ray powder difratogram to ZrO_2: 8 mol % In_2O_3.

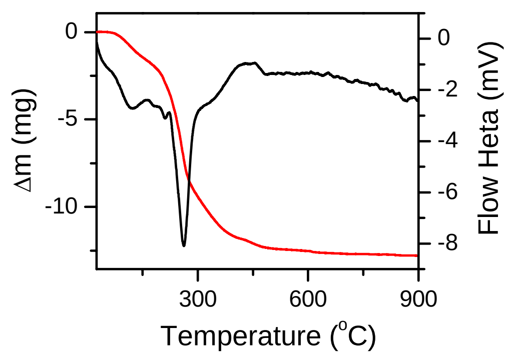

Figure 2: Thermal decomposition and Heat flow plots to ZrO_2: 8 mol% In_2O_3 obtained by a nitrate thermal decomposition method

References

[1] D. Z. de Florio and R. Muccillo, Mat. Res. Bull., **39** (2004) 1539 – 1548.
[2] L. J. Gauckler and K. Sasaki, Solid State Ionics, **75** (1995) 203 – 210.