E2-27: Lithium ion conducting solid electrolyte based on magnesium and aluminium composite hydroxide

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Solid electrolytes have attracted the attention of material scientists owing to their possible applications as dry electrolytes in compact batteries, fuel cells, gas sensors etc. In this communication, results on a novel solid electrolyte based on Mg and Al composite hydroxide on which Li^+ acts as a conducting ion, are presented.

The electrolyte was prepared by mixing stoichiometric amounts of $Al(NO_3)_3.9H_2O$, $Mg(NO_3)_2.6H_2O$ and LiOH. Al and Mg hydroxides were then co-precipitated and the composite also contained Li^+. This mixture, heated to 85°C for 18 h with constant stirring, resulted in a white slurry which was centrifuged, decanted and rinsed with distilled water. The powder thus prepared was pressed into a pellet and dried at 150°C in a Muffle furnace. This compound had a room temperature conductivity of 3.40×10^{-5} S cm^{-1} possibly due to bound water acting as an ionic conductor. This was confirmed by the fact that the conductivity of the material, heat treated at about 150°C to remove water, showed a much less conductivity of 1.80×10^{-6} S cm^{-1}. The conductivity of the material was then increased to a maximum value of 6.00×10^{-2} S cm^{-1} on increasing the temperature to 350°C. Further increase in temperature resulted in a decrease of the conductivity, showing the typical ionic conducting behaviour. The repeated washing of the compound with distilled water resulted in decrease of conductivity to a very low value such as 10^{-8} S cm^{-1} at 350°C. The water soluble and water insoluble parts were separated. Both these had no appreciable conductivity at high temperature. X-ray powder diffraction studies and Differential Thermal Analysis confirmed that the water soluble part contained $LiNO_3$ and the insoluble part consisted of the Mg and Al composite hydroxide. The solid electrolyte had a Li^+ ion conduction at high temperature where Li^+ was probably mobile on the composite Mg, Al hydroxide particles.