ABSTRACT of the thesis entitled

Field Effect and Charge Transport Properties of Graphene Oxide-Zinc Oxide Nanocomposites

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Graphene oxide (GO), an intermediate material for the chemical synthesis of graphene, is an insulator. When reduced by chemical or thermal methods to retain its conductivity, reduced GO shows p-type dominant behaviour as channel layer for transistor applications. Therefore in the present investigation to induce n-type conductivity in GO, zinc oxide (ZnO) nanostructures are anchored onto GO surface and the field effect and transport properties are studied in graphene oxide-zinc oxide (GO-ZnO) nanocomposites. The insulating behaviour of GO, however, was studied for resistive switching characteristics in aluminium/GO/semiconductor structures. In non-volatile memory cells (metal-GO-metal) with GO as active layer, cross talk between adjacent cells is present due to low (< 10) rectification ratio. Therefore the bottom metal electrode in metal-GO-metal structures was replaced with semiconductors such as Si or Ge such that intrinsic rectifying characteristics of Si (or Ge) supress the cross talk in GO based memory cells. The conductivity of GO was increased by loading (5 wt % to 25 wt %) ZnO nanostructures in GO matrix. Initially for low concentrations of ZnO (5 and 10 wt %), the field effect transistors fabricated with GO-ZnO nanocomposites as channel layer showed ambipolar but p-type dominant transfer characteristics. The p-type conductivity in GO-ZnO is due to partial reduction of GO with low ZnO concentrations (from X-ray photoelectron spectroscopic study) and therefore the conduction is prominent through oxygen functional groups. As the concentration of ZnO was increased, the n-type dominant conduction was also increased. In GO-ZnO composites with 15 wt % ZnO, the conductivity was nearly ambipolar and n-type dominant conduction was observed for 20 and 25 wt % of ZnO. Therefore the transition from p-type to n-type in GO-ZnO composite was occurred for ZnO concentration between 15 to 20 wt %. From an analysis of the temperature dependence resistance it is found that both GO and GO-ZnO nanocomposites follow the Mott-Variable range hoping type of charge transport.

Key words: graphene oxide, zinc oxide, nanocomposites, transistors, charge transport