I-V and C-V characterization of semiconductor thin films

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ABSTRACT
Cuprous oxide (Cu$_2$O) and ZnSe thin films were potentiostatically electrodeposited on indium-doped tin oxide (ITO) substrates in order to investigate the I-V and C-V characteristics of ITO/n-Cu$_2$O/(p-Cu$_x$S or metal or electrolyte) and ITO/p-ZnSe/electrolyte systems. An electrochemical cell containing aqueous solutions of 0.1 M sodium acetate and 1.6x10$^{-2}$ M cupric acetate was used for electro deposition of Cu$_2$O thin films on ITO-coated glass substrates. Potentiostatic condition of -250 mV against standard calomel electrodes (SEC) was used for the electro deposition. To convert the top layers of the Cu$_2$O to Cu$_x$S by sulphidation, exposed the surface to a spray of aqueous solution of sodium sulphide or to a mixture of hydrogen sulphide and nitrogen gases to foam ITO/n-Cu$_2$O/p-Cu$_x$S system. For the system ITO/n-Cu$_2$O/metal, metal layer was evaporated on to the n-Cu$_2$O surface. An electrolyte of 0.1 M sodium acetate was used in the ITO/n-Cu$_2$O/electrolyte system. Electro deposition of ZnSe thin films were carried out under potentionstatic condition at -550 mV against SCE using aqueous solutions of 0.1 M ZnSO$_4$ and 10$^{-5}$ M SeO$_2$ at the temperature of 65$^\circ$C. The theoretical and experimental I-V characteristics of ITO/n-Cu$_2$O/(p-Cu$_x$S or metal or electrolyte) system suggest that Cu$_2$O films made on ITO substrate form Schottky type junctions at the back contact in addition to the Cu$_2$O/(p-Cu$_x$S of metal or electrolyte) junctions. Furthermore, C-V characteristics suggest that the doping concentration of the Cu$_2$O layer is in the order of 10$^{18}$. Light and dark I-V measurements of doped and undoped ITO/ZnSe in KI electrolyte suggest the p-type photoconductivity in this system and C-V measurements confirmed it.

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