

Abstract

Polymers have emerged as promising materials for numerous scientific and technological applications in the recent times. Considering the bulk properties of polymers an effort has been made to modify the structural, optical, electronic and dielectric properties of surface of the polymer by ion implantation. Among the various modification techniques, ion implantation has been found to be most efficient and useful technique capable of tailoring physical and chemical properties by depositing a thin conductive layer in the insulating polymers. For this purpose, Polymethylmethacrylate (PMMA) and polycarbonate (PC) polymer samples were implanted with 500keV Cu⁺ ions of fluence ranging from 1×10^{12} to 1×10^{14} ions/cm². Simulation of ion implantation and damage processes generated in PMMA and PC is performed by using well-known software package named 'Stopping and Range of Ions in Matter' (SRIM). Modifications induced in structural, chemical, optical and electrical properties of ion-implanted polymers have been investigated as function of implantation fluence. Various characterization techniques were used to analyze these materials, like X-ray diffraction(XRD) for structural analysis, UV-visible plus photoluminescence spectrophotometry to investigate the optical behavior and FTIR for the verification of the existence of functional groups. X-ray Diffraction(XRD) study indicated a relatively lower variation with a higher dose of ions. Fourier Transform Infrared (FTIR) spectra exhibited that with the implantation of Cu ions the intensity of existing bands decreases, while the result confirms the existence of a C=C group. The pristine and ion-implanted samples were also investigated using photoluminescence (PL) and Ultra Violet-Visible (UV-VIS) spectra. The optical band gap (E_g) was observed up to 3.05 eV for the implanted samples, while the pristine sample exhibited a wide energy-gap up to ~3.9 eV. The dielectric measurements of the pristine and Cu-implanted PMMA were investigated in the 10 Hz to 2 GHz frequency range. It was found that the implanted samples showed a significant decrease in the value of the dielectric constant. 500 keV Cu ions were implanted in polycarbonate matrix to investigate the impact on different properties. XRD results revealed shifting of hallos towards lower 2θ positions by Cu ion implantation. FTIR spectra revealed no significant chemical changes by Cu implantation in polycarbonate matrix. A successively decreasing band gap was observed in polycarbonate samples by increasing Cu ion fluence. The band gap varied from 3.08 to 2.61 eV. Dielectric profiles and I-V plots revealed better electrical properties of polycarbonate by Cu ion implantation. These types of materials can be utilized for fabricating the frames for sensitive measuring devices (digital electrometers and digital balances, etc.) to overcome the problem of electrostatic charge agglomeration.