ABSTRACT

Radiation sensors based on carbon nanotubes (CNTs) have gained a great deal of interest in recent years due to their high sensitivity. However, improvement in the performance of these detectors is still desirable. In this work, multi-walled carbon nanotubes (MWCNTs) based Gamma radiation detector was fabricated and characterized. In order to improve the performance of the detector, Polyaniline (PANI) was added to the MWCNTs using a chemical method. The PANI was synthesized via chemical-oxidation procedure by using ammonium persulphate and hydrochloric acid. The MWCNTs and PANI/MWCNTs were characterized using X-ray Diffraction (XRD), Raman Spectroscopy, Field Emission Scanning Electron Microscope (FESEM), Thermogravimetry and Digital Probe Station. The XRD results showed (002) and (100) oriented diffraction peaks of carbon in the MWCNTs whose intensity was reduced and width was increased due to the addition of PANI in the MWCNTs structure. The interatomic spacing'd' in the case of PANI/MWCNTs was higher than that of the MWCNTs. The Raman spectroscopy results revealed graphitization (G) and defects (D) band peaks of the MWCNTs. The G-band peak resulted due to in-plane vibrations of SP2 bonded carbon atoms whereas the presence of D-peak was due to the out-of-plane vibrations of the carbon atoms, indicating structural defects in the material. The intensity ratio (I_D/I_G) was increased due to the addition of PANI in the MWCNTs matrix. The FESEM image of pristine MWCNTs showed CNTs structure that became thicker due to the wrapping up of PANI in the MWCNTs matrix. The Thermogravimetry analysis (TGA) of the PANI/MWCNTs indicated its high thermal stability up to 420 ^{o}C. Afterward, the thermal stability of the matrix was decreased. The drop-casting method was used to fabricate PANI/MWCNTs based radiation sensor. The sensitivity of the PANI/MWCNTs towards gamma radiations was studied by using a Keithley digital probe station. The change in the resistance of the sensor was recorded before and after the radiation exposure rates at different time intervals. The measurements were taken out at two different exposure rates of gamma irradiation such as 5 and 10 R/min. The PANI/MWCNTs device exhibited a remarkable change in its resistance to gamma radiation, indicating its high sensitivity.

The % change in the resistance of the device was found to be 15 % at 5 R/min which was increased to 25 % with the increase of the radiation dose rate to 10 R/min.