Abstract

With the advancement of nuclear and isotope technology, Ionizing Radiations have wide applications in various fields. While working with radiation sources or in accidental/nuclear or radiological emergency conditions, humans may be exposed to these radiations directly or indirectly by internal radioactive contamination. Exposure to these radiations may lead to several health hazards. Protection against these radiations demands detector materials for conversion of radiation energy to some effects which can be measured. ZnO and TiO_2 materials are considered to study the effects of radiation and measure prompt UV-Vis emission (Scintillation) or changes in electrical properties and correlated with radiation exposure. The thesis work aimed to synthesize ZnO and TiO_2 nanostructure/polymer composites using cost-effective methods for sensing and measuring various types of ionizing radiations such as Alpha, Neutron and Gamma radiations.

In this thesis work, metal oxide nanostructure and composite-based sensor material are developed by cost-effective method for detecting and measuring Alpha, Neutron and Gamma radiations. ZnO:Ga Nanorods, prepared using the low-temperature hydrothermal process, showed a good response to alpha radiation. Another sensor material developed is ZnO/Polystyrene composite scintillator for alpha radiation detection, which is very sensitive with minimum detectable activity ~0.4 Bq. This alpha detector is modified by embedding ^{6}LiF, as the neutron absorber and generating alpha particle during absorption, sensed by ZnO scintillator. ZnO-^{6}LiF/PS has shown a promising response to thermal neutron radiation. The advantage of these composites is that these can be easily prepared in different size and shape because of the flexible polymer base. Further, TiO_2 nanorods (NR) over FTO/glass substrate are developed using hydrothermal method as sensing material for gamma radiation doses. The current-voltage (I-V) measurement changes were observed with exposure to different gamma doses. These changes are linear with the dose exposed and thus, TiO_2 NR/FTO/Glass system is promising materials which can be used as a gamma radiation dosimetry application.