A B S T R A C T

Processing by ionizing radiation is an expanding technology with numerous applications such as health care, sterilization of medical products, pasteurization, water purification, hospital waste treatment, polymer modification, food irradiation, etc. The effectiveness of the exposure process depends on the proper application of the radiation dose and its measurement. The required dose would depend upon both the product and the effect desired. Adequate dosimetry with proper controls and documentation is the main key factor of the quality control process, which is quite necessary to assure that the products are treated properly.

The metal oxide film based technology for sensing ionizing radiation has recently been praised by many due to its low-cost and efficient detection methods. After decades of research and development activities, these radiation sensors are now used in a variety of applications including the gamma sensing. However, challenges still remain in the area of sensitivity, response, power consumption and recovery. Therefore, improvement of metal oxide sensors by the incorporation of various technologies is quite important. In this area, the modification of the metal oxide based sensors by thermal annealing was investigated. The research work presented in this thesis explored methods of enhancing the sensitivity of the indium oxide films in gamma radiation sensing through changes in the structural, optical and electrical characteristics by thermal annealing at appropriate temperature. The measurements on indium oxide films confirmed the thickness, crystallization, crystal structure, grain size, etc. A fabrication process consisting of two lift-off processes for the indium oxide and contact metal was developed to create the prototype devices. Maximum sensitivity was achieved in these devices at the annealing temperature of 400˚C.

A part of the research work was on optimization of the gamma sensing using the tellurium dioxide thin films of thickness 600 nm. Various analytical techniques were used to characterize the structure and the composition of these films. As expected, the TeO_2 sensors exhibited highest response for gamma sensing with the optimum thermal treatment at relatively low temperature of 150˚C. Therefore, these techniques can be utilized to manufacture gamma radiation sensors using metal oxide thin films.

In summary, the sensing studies performed showed that the post-deposition thermal annealing produces excellent response and highest sensitivity in comparison to the as-deposited samples. Also, at the end of the thesis, the guidelines for future work are given.

Keywords: Indium oxide, Tellurium dioxide, Thin film, Gamma radiation dosimetry, Sensitivity.