

Radiation damage effects on zinc oxide (ZnO) based semiconductor devices– a review

ABSTRACT

In space, semiconductor devices are vulnerable to various effect of high energy radiation, causing single event upsets (SEUs), damaging or altering the lattice structure of the semiconductor device. The effect of ionizing radiation on metal oxide semiconductor device had been receiving very little attention as most research focus on polycrystalline silicon-based semiconductor. Based on our previous research studies specifically on gamma ra-diation exposure, the interaction effects of radiation towards ZnO based semiconductors shows changes across all 4 different types of parameter, namely the morphology, structural and optical as well as the electrical properties. As a general classification, morphological change is attributed to the interaction within the crystal lattice, while structural distortion is due to high energy displacement cascade, whereas changes in the optical properties re-lates to the formation of colour centres (F-centre). The overall parametric changes will then affect the electrical properties as degradation of general parameters will lead to the increase of the ideality factor of the ZnO semiconductor device. The increase of the ideality factor after irradiation is attributed to the production of recombination centres in the space charge region. Furthermore, large values of the ideality factor, obtained after irradiation, point out extrinsic recombination mechanisms where the initial and final states of recombination are located at a lattice imperfection such as a dangling bond or a complex involving impurity atoms and vacancies. Therefore, in this paper a more thorough review of past research on the radiation related studies on ZnO is discussed. This review aims to provide an in-depth discussion on various radiation effects of zinc oxide based semiconductor devices.