Energy Band Bending induced Carrier Recombination Enhancement in Lateral PNP Bipolar Transistor Exposed to Mixed Neutrons and Gamma Rays

Chenhui Wang[1], Yan Liu[1], Wei Chen[1], Xiaoming Jin[1], Xiaoyan Bai[1] and Xiaoqiang Guo[1]

[1] *State Key Laboratory of Intense Pulsed Radiation Simulation and Effect, Northwest Institute of Nuclear Technology, China*

Abstract

Lateral PNP bipolar transistor (LPNP) is the most vulnerable kind of device in bipolar integrated circuits when exposed to the mixed irradiation of neutrons and gamma rays. Under the mixed irradiation, LPNP exhibits ionizing/displacement synergetic effects and has more severe current gain degradation than that under the individual neutron or gamma irradiation. In this paper, a model concerning the energy band bending induced carrier recombination enhancement was developed to simulation the ionizing/displacement synergetic effects in LPNP. Based on the model, the physical mechanism of the synergetic effects was well explained and the influencing factors were deeply analyzed. The results indicate that gamma-induced energy band bending in the subsurface of Si/SiO_2 interface enhances the carrier recombination in neutron-induced displacement defects in bulk silicon, leading to more severe current gain degradation under the mixed irradiation.