

Experiment and Simulation Research of the Displacement Damage Effects in CMOS Image Sensors Irradiated by Neutrons

Z.J. Wang¹, Y.Y. Xue¹, W. Chen¹, X. Nie², G. Hang², S.K. Lai², B.P. He¹,
W.Y. Ma¹, J.K. Sheng¹, S.L. Gou¹, Z.B. Yao¹, M.B. Liu¹

¹ *National Key Laboratory of Intense Pulsed Radiation Simulation and Effect,
Northwest Institute of Nuclear Technology, Xi'an, 710024, China*

² *School of Materials Science and Engineering, Xiangtan University, Hunan,
411105, China*

wangzujun@nint.ac.cn

Abstract

The displacement damage effects in pinned photodiode (PPD) CMOS image sensors (CISs) irradiated by neutrons are researched by experiment and simulation. The degradations of the CISs induced by neutron beams are analyzed to verify the typical characteristics of the displacement damage effects. The degradations of the dark signal, dark signal non-uniformity, and dark signal spikes are presented. The simulation of the neutron-induced dark signal increase is carried out by TCAD software. The influences of the different types of bulk traps such as multi-vacancy center, divacancy center and C_i-O_i center induced by neutron beams are simulated. By combining the radiation experiments and simulation, the mechanisms of the displacement damage in the CISs induced by neutron beams are analyzed. The research will provide the basis of the theories and experimental techniques for neutron radiation damage evaluation and radiation hardening techniques of the PPD CISs.