

Investigation of Threshold Voltage Shift in Gamma Irradiated N-Channel and P-Channel MOS Transistors of CD4007

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Abstract : The ionizing radiations cause different kinds of damages in electronic components. MOSFETs, most common transistors in today's digital and analog circuits, are severely sensitive to TID damage. In this work, the threshold voltage shift of CD4007 device, which is an integrated circuit including P-channel and N-channel MOS transistors, was investigated for low dose gamma irradiation under different gate bias voltages. We used linear extrapolation method to extract threshold voltage from I_D - V_G characteristic curve. The results showed that the threshold voltage shift was approximately 27.5 mV/Gy for N-channel and 3.5 mV/Gy for P-channel transistors at the gate bias of $|9\text{ V}|$ after irradiation by Co-60 gamma ray source. Although the sensitivity of the devices under test were strongly dependent to biasing condition and transistor type, the threshold voltage shifted linearly versus accumulated dose in all cases. The overall results show that the application of CD4007 as an electronic buffer in a radiation therapy system is limited by TID damage. However, this integrated circuit can be used as a cheap and sensitive radiation dosimeter for accumulated dose measurement in radiation therapy systems.

Keywords : threshold voltage shift, MOS transistor, linear extrapolation, gamma irradiation

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