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Gamma, neutron, proton irradiated p-type silicon MOS capacitors with aluminium oxide.

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We report on the study of response of the MOS capacitor with atomic layer deposited (ALD) Al_2O_3 layer on p-type silicon substrate to neutron, proton, and gamma irradiation. Alumina films are prominent for use as passivation layers in silicon radiation detectors instead of surface electron accumulation termination structures as alumina forms negative oxide charge on the silicon-oxide interface. In order to investigate the interface charges and surface damage after irradiation with different particles electric characterization of MOS capacitors were conducted by capacitance-voltage measurements. The results are described in correlation with the changes in effective oxide charge. TCAD simulations accompanied the study. The flat band and hysteresis of C-V curves after gamma irradiation showed development of mobile charges in dielectric film. Proton and neutron irradiated samples demonstrated decrease of capacitance in the accumulation region which can be explained by displacement damage. At the same time, the observed shift of effective oxide charge with increase of irradiation indicates the surface charge accumulation. The findings of bulk damage were described by a creation of BiO_i level.

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