

Compensation for radiation damage of SOI pixel detector via tunneling

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We are developing a method for removing trapped holes in the oxide layer of SOI monolithic pixel detector after irradiation.

Radiations that pass through detector generate electron-hole pairs in the oxide layer.

The holes are captured in the oxide layer due to lower mobility than the electron's.

Positive potential of these trapped holes modify characteristic of MOSFETs of signal readout circuit.

In order to compensate the effect of positive potential, we tried to annihilate the trapped holes by using the electrons via Fowler-Nordheim tunneling.

Applying high voltage to the oxide layer with MOSFET and buried p-well (BPW) under the oxide layer as electrode for 0 V and high voltage respectively, the electrons are injected into the oxide layer through junction of Si-SiO₂ by FN tunneling.

The sample which has different body type, gate length and width of MOSFETs was used. Before and after irradiation, I_d - V_g was measured to evaluate characteristic of MOSFETs such as threshold voltage, V_{th} .

Current during applying high voltage to the BPW (I_{bpw} - V_{bpw}) also measured to make sure of FN tunneling.

The sample was irradiated with X-ray up to 1 kGy, and then negative shift of V_{th} occurred.

FN plot which derived from I_{bpw} - V_{bpw} showed linearity at $V_{bpw} \geq 120$ V.

This linearity indicates FN tunneling from Si surface of the BPW into the oxide layer.

We succeeded to recover V_{th} close to pre-irradiation level after applying $V_{bpw} \geq 120$ V.

Other recent progress of this study will be shown in presentation.

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Session Classification: After dinner POSTER session, with drinks: (All presenters are requested/encouraged to attend their posters; All participants are requested to participate the session, with drinks!)

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