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Elongation of LED lighting lifetime under X-ray dominant radiation environment

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In everyday the lighting environments is increasingly replacing incandescent and fluorescent bulbs with light-emitting diodes (LEDs), which offer superior electricity-to-light conversion efficiency. In accelerator facilities, too, the time has come to replace conventional lighting with LEDs and other high-efficiency, green lighting. In order to promote the replacement of lighting in an accelerator tunnel, we investigated the process of the radiation damage for commercially available LED lightings in an X-ray radiation environment such as in the electron storage ring SPring-8. It was found that metal-oxide-semiconductor field-effect transistors (MOSFETs) to be supply power for the LED lighting were damaged by X-ray irradiation with the total dose effect greater than several hundred Gy (air kerma). In situ measurements of the MOSFET under an irradiation by an X-ray tube clearly showed a sudden increase of the off-state drain current accompanying with a sharp increase of MOSFET temperature as a function of radiation dose, which eventually caused the device failure. This presentation shows two effective countermeasures for the longer lifetime of LED and application examples.

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