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Before and after irradiation performance of IHEP-IME LGAD sensors

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The High Granularity Timing Detector (HGTD) project of ATLAS will reduce the pile-up effect in HL-LHC by providing precise time measurement of tracks. The Low Gain Avalanche Detector (LGAD) with a time resolution better than 35(70) ps before(after) irradiation is the key technology that has been studied by many institutes. The Institute of High Energy Physics Chinese Academy of Science (IHEP) has been developing LGAD sensors IHEP-IME with the Institute of Microelectronics of the Chinese Academy of Sciences (IME). So far two versions of IHEP-IME LGAD sensors have been produced, IHEP-IMEv1 and IHEP-IMEv2. IHEP-IMEv1 sensors showed good potential in achieving the HGTD requirements. IHEP-IMEv2 sensors have a modified doping profile compared with the last version, especially focusing on the carbon implantation effect. Sensors with diverse producing processes and carbon doses were fabricated and have shown improved performance. What's more, full-size sensors (with 15x15 pads) were produced. Sensors were irradiated with neutron influences of 0.8e15 neq/cm2, 1.5e15 neq/cm2, and 2.5e15 neq/cm2. This talk will present the test results of IHEP-IMEv2 sensors performance before and after irradiation, including single pad and large array sensors. After irradiation, sensors with different carbon doses showed different performances. The effect of carbon implantation will be shown. Low-temperature beta test results showed that after 2.5e15 neq/cm2 irradiation sensors collect 4 fC at less than 400 V with a time resolution better than 50 ps, by far satisfying the requirements.

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