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Processing of Cadmium Telluride (CdTe) X-ray pixel detectors

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We report a fabrication process of pixel detectors made of bulk Cadmium Telluride (CdTe) crystals. Prior the processing the quality and defect density in CdTe material was characterized by infrared (IR) spectroscopy. The semiconductor detector and Flip-Chip (FC) interconnection processing was carried out in clean room premises of Micronova center in Espoo, Finland. The chip scale processes consist of the aluminum oxide (Al₂O₃) low temperature thermal Atomic Layer Deposition (ALD), titanium tungsten (TiW) metal sputtering depositions and an electroless Nickel growth. The CdTe crystals the size of 10 × 10 × 0.5mm³ were patterned with several photo-lithography techniques. In this study, gold (Au) has been chosen as the material for the wettable Under Bump Metallization (UBM) pads. The application-specific integrated circuits (ASIC) PSI46dig read out chip (ROC) with double 80 pixel columns and 26 rows resulting in 4160 pixels in 1 cm² area. Indium (In) based metallurgy solder bumps were grown on the CdTe detectors using a low temperature FC bonding technique. The In-Au cold weld bonding connections were successfully connecting both elements. After the processing the detector packages were wire bonded into associated read-out electronics. The pixel modules were tested at the premises of Finnish Radiation Safety Authority (STUK). During the measurement campaign, the modules were tested by exposure to a Cs¹³⁷ source of 1.5 TBq for 8 minutes. We detected at the room temperature a photopeak at 662keV with about 7% energy resolution.

Primary author: Ms GÄDDA, Akiko (Helsinki Institute of Physics (HIP), Helsinki, Finland. Advacam Oy, Espoo, Finland)

Co-authors: Mr WINKLER, Alexander (Helsinki Institute of Physics (HIP), Helsinki, Finland); Ms OTT, Jennifer (Helsinki Institute of Physics (HIP), Helsinki, Finland); Dr LUUKKA, Panja (Helsinki Institute of Physics (HIP), Helsinki, Finland); Ms KOPONEN, Pirkitta (Helsinki Institute of Physics (HIP), Helsinki, Finland); Dr KARADZHINOVA-FERRER, Aneliya (Ruder Boskovic Institute (RBI), Zagreb, Croatia); Mr VÄHÄNEN, Sami (Advacam Oy, Espoo, Finland); Mr TIKKANEN, Joonas (Radiation and Nuclear Safety Authority (STUK), Helsinki, Finland); Dr HÄRKÖNEN, Jaakko (Ruder Boskovic Institute (RBI), Zagreb, Croatia)

Presenter: Ms GÄDDA, Akiko (Helsinki Institute of Physics (HIP), Helsinki, Finland. Advacam Oy, Espoo, Finland)

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