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AC—coupled pitch adapters for silicon strip detectors

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Silicon strip detector modules that are used in tracker systems of high energy physics experiments consists of readout hybrid board, the sensor itself and pitch adapter (PA) in between hybrid and sensor. Modern strip detectors are almost exclusively AC-coupled because of high leakage current due to the harsh radiation environment. The AC-coupling requires resistive isolation of implanted strips from the DC-biasing circuit. Strip isolation is commonly realized by integrated poly-silicon bias resistors, where the resistance value is typically around 1M Ω. We present a novel approach for implementing the AC-coupling in the pitch adapter. AC-coupled PA's have been processed on ordinary glass glass wafers. The two layer fan metallization is aluminum and the intermediate capacitor insulator is aluminum oxide (Al2O3) deposited by the Atomic Layer Deposition (ALD) method. ALD is self-limiting Chemical Vapor Deposition (CVD) process, which characteristically results in pinhole-free thin films. The temperature of ALD Al2O3 deposition is 300ˆ0C, thus it is appropriate for standard glass wafers, which are limited to about 400ˆ0C in process steps. The bias resistors are made on the glass wafer by sputtering tungsten nitride (WNx). The deposition of WNx takes place at approximately room temperature and the resistors are patterned by wet etching with hydrogen peroxide. The electrical characterization of AC-coupled PA's indicate very good breakdown performance of the Al2O3 capacitors and homogeneity of WNx resistance values. A DC-coupled n+/p-/p+ strip detector made of p-type Fz-Si and irradiated with protons to a fluence of 3×10ˆ14 neq/cm2 was attached to the CMS APV readout hybrid with an AC-coupled PA. The strip detectors size is 4cm × 4cm and it has 768 strips. Our test beam results indicate a signal-to-noise ratio of 27 for this module.

Author: HAERKOENEN, Jasu (Helsinki Institute of Physics HIP)

Co-authors: Dr TUOMINEN, Eija (HIP); Dr TUOVINEN, Esa (HIP); Mr MOILANEN, Henri (HIP); Dr SPIEGEL, Lenny (FNAL); Dr LUUKKA, Panja (HIP); Mr MÄENPÄÄ, Teppo (HIP); Dr GOTRA, Yuri (FNAL)

Presenter: HAERKOENEN, Jasu (Helsinki Institute of Physics HIP)

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