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Atomic Layer Deposition (ALD) grown thin films for ultra-fine pitch pixel detectors

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In particle physics applications, the innermost pixel detectors will face in the future unprecedented requirements. Due to the increasing luminosity, the charge collection distance will be degraded to be less than physical segmentation of existing pixel devices resulting in poor particle tracking performance. Obvious approach to maintain sufficiently good spatial resolution is to increase the granularity of tracking detectors, i.e. downscaling the pixel size. Presumably, implementation of p-stop and/or p-spray structures, needed in radiation hard n on p pixel devices, will become challenging. Furthermore, in case of DC-coupled pixel sensor design, integrated bias resistors are required for quality assurance by IV-probing of a sensor prior valuable Flip-Chip bonding and module assembly processes. As a consequence of the small pixel size, the realization of traditional punch-through biasing becomes very difficult.
ALD is known as a method producing pinhole-free thin films due to it's self-limiting surface chemistry growth mechanism. It is possible with ALD to engineer oxide and interface charge type and density at dielectric-silicon interfaces enabling surface current termination in n on p detectors by negative oxide charge. We have studied the use of ALD thin films as resistor material for the future pixel sensor applications. We will present the results of Titanium nitride (TiN) thin films grown by plasma enhanced atomic layer deposition (PEALD). In very high luminosity environment, it would be favorable to isolate capacitively the DC leakage current from the input of the readout ASIC. In this contribution, we will discuss the approach to use ALD grown dielectric films as capacitive coupling (AC-coupling) layers due to their potentially high capacitance density.

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