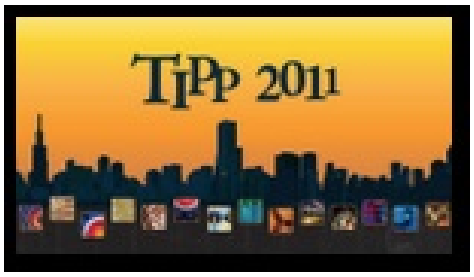

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High-Resolution Photon Counting Detector using Solid-State Photomultipliers

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There is a strong interest in photon counting detectors for applications in the medical, biological and materials research. To meet this interest, we are developing a novel high-spatial resolution photon counting detector capable of detecting low energy gamma rays using solid-state photomultipliers (SSPM). SSPMs are used as gamma ray detectors by coupling them to scintillators, where the lower detection energy limit is set by the dark noise of the SSPM and brightness of the scintillator. This limit can be lowered by using a bright scintillator and minimizing the light loss in the interface. To achieve this, we have developed a method of depositing scintillators directly on SSPMs and similar detectors. This concept has been verified by vapor deposition of CsI:Tl on SSPMs. The CsI:Tl is grown on the SSPM surface as densely packed, highly oriented, microcolumnar crystals, which channels the scintillation light towards the SSPM to give excellent sub-pixel resolution. The microcolumnar structure eliminates the need for pixelating the scintillator, thereby increasing the detector sensitivity and simultaneously reducing processing costs.
Commercially available SSPMs from SensL Technologies were used in this study. The SSPMs were 3.0x3.0 mm2 in individual package and also in a 4x4 arrays. Using our technique we were successful in directly depositing a very uniform 750 μm thick layer CsI:Tl on these SSPMs. The SSPMs tolerated the deposition process and the dark noise of the SSPMs was unchanged. The fabricated detectors were imaged using a scanning electron micrograph, which showed highly oriented microcolumnar structure orthogonal to the SSPM face. The performance characteristics of the detector in terms of position sensitivity, energy resolution, timing characteristics and signal to noise ratio were studied and will be reported. The significant result so far is that the photopeak can be realized for a wide range of energies including Am-241 (60 keV) and Co-57 (129 keV).

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