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P2.38: Development of near-infrared-sensitive single photon avalanche diode prototypes for a quantum ghost imaging system

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Detection of photons in the near-infrared (NIR) range is utilized to implement several quantum imaging and key distribution techniques for remote sensing [1-3]. Our research group is working on a quantum ghost imaging system (QGIS) project that aims to obtain images of distant objects using entangled photons in the NIR region. The photon source exhibiting quantum correlation is composed of a 1554 nm signal photon and an 809 nm idler photon which are generated through spontaneous parametric down-conversion by injecting a 532 nm pump beam into a periodically poled lithium niobite (PPLN) crystal. We have confirmed that the point source is feasible [4] and are now developing a line source to reduce the imaging acquisition time. To detect the 1D idler photons, we are also working on a NIR-sensitive single photon avalanche diode (SPAD) 1D array. In the first stage of the SPAD array development, single SPAD prototypes of different sizes were designed at the Korea Advanced Institute of Science and Technology (KAIST) and fabricated in a 180 nm CMOS technology at the Advanced Micro Foundry (AMF). This study presents the results of the characterization of NIR-sensitive SPADs that operate with a passive quenching mechanism. The key parameters required in QGIS, such as the dark count rate (DCR) and photon detection efficiency (PDE), were evaluated. As a result, the PDE (@ 810 nm) for a SPAD with an area of 60 x 60 um2 ranged from 5% to 25%, and the DCR was at the level of 2 to 75 kHz. Although the results from this prototype are promising, there are still areas that need to be solved to enhance its performance in the future.

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