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Spectroscopic characterization of GaAs/AlGaAs avalanche photodiodes with separate absorption and multiplication regions

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Owing to its high atomic number GaAs is an attractive material to realize hard-X-ray single-photon detectors. In fact, its bandgap of 1.42 eV is on the one hand sufficiently wide to operate it at room temperature and on the other hand small enough to provide reasonable spectroscopic performances for high-energy photons. Therefore, III-V semiconductors avalanche photodiodes have been developed to be utilized as X-ray spectroscopic devices. These have been grown by molecular beam epitaxy and comprise of separate absorption and multiplication regions, which are divided by a nanoscale carbon layer. Utilizing a low-noise charge-sensitive preamplifier and sources of characteristic fluorescence lines, several X-ray spectra have been collected at room temperature.
In this work we present some devices featuring different concentrations and thicknesses of the aforementioned carbon layer. These devices have been characterized in dark and under illumination conditions. The results are reported here together with a thorough noise analysis and the acquired X-ray spectra will be discussed.

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