Contribution ID: **93** Type: **Poster**

Nano focused synchrotron radiation for the thorough characterization of avalanche photodiodes and quantum well detectors with engineered band gap based on III-V semiconductors

Tuesday, 17 May 2022 18:50 (1h 10m)

We recently developed nano-engineered, high Z compound semiconductors avalanche photodiodes and quantum-well detectors for ultra fast single photon detection in a wide wavelength. The availability of ultra fast photon detection is of paramount importance in all fields of science and technology. These detectors are based on quantum well technology in particular on GaAs/AlGaAs hetero-junctions grown by molecular beam epitaxy. Compared to state-of-the-art Si photon counters they possess inherent advantages such as shorter absorption length for high energy x-rays and larger electronic mobility, which translate into thinner devices and shorter response times. Moreover, utilizing a super-lattice structure consisting of nanometre-sized and alternating layers of compound semiconductors the noise associated with charge multiplication is minimized. While their photon response and the successive charge transport can be simulated it is essential for their fine tuning to verify the obtained results experimentally. Using a scanning x-ray microscopy approach in combination with the synchrotron bunch structure it is possible to elucidate absorption, drift and diffusion properties through mesh scans and subsequently resolve the internal field distribution within the detectors. We will present both the quantum devices and the experimental apparatus and demonstrate how synchrotron radiation can contribute to advancements of quantum detector technologies.

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Session Classification: POSTER SESSION 2 - Cheese and wine