SINGLE INDIUM PHOSPHIDE NANOWIRE DIODES AS ULTRAHIGH-RESOLUTION DETECTORS FOR IMAGING X-RAY AND OPTICAL FOCI

Nils Lamers, Lert Chayanun, Kristi Adham, Lukas Hrachowina, Magnus Borgström, Jesper Wallentin

Indium phosphide optoelectronic devices are a well-established technology, with much ongoing research focusing on nanoscale structured devices such as nanowires (NW) to leverage improved optical and carrier mechanics found at the nanoscale. Here, we leverage not just the high optoelectronic performance of epitaxially-grown InP NWs, but also the high resolution that is possible when only a single NW is contacted. When combining such a device with a high-precision sample stage, it becomes possible to image the shape, intensity distribution, and formation of nanoscale x-ray and laser foci via x-ray beam induced current and optical beam induced current methods. Single InP NW with an axial p-i-n junction and with diameters of 60 nm are as-grown the growth substrate by depositing an isolation layer and aligning the top-contact pattern to the growth pattern via electron beam lithography. The resulting devices show ideality factors of 2 and low dark currents around 10 fA. High-resolution 3D images the X-ray focus of the NanoMAX beamline at MAX IV are recorded using the devices, with the resolution limited by the stage stability. The focus shape agrees with what ptychography calculations predict [1]. In future, the optical effects from different elements introduced into the beam could be measured and verified, creating a stronger link between theoretical calculations and practical effect in constructing nanofocused optical paths.