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Quantum optics with shaped nanowires

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Semiconductor nanowires offer a powerful platform for engineering light at the nanoscale by controlling their size and shape in order to guide light efficiently and minimize undesired reflections. In this work, we have shaped the nanowires with a unique tapering to realize bright quantum dot based entangled photon sources and high efficiency quantum detectors. In the first part of the talk, the on-demand generation of entangled photon pairs with a quantum dot in a tapered nanowire waveguide will be discussed. These results will be put in perspective with respect to state-of-the-art entangled photon sources with the viewpoint of going beyond in the future towards near-unity fidelity and efficiency. Reaching near-unity fidelity and efficiency has proven elusive with leading photon technologies due to the probabilistic nature of the generation process. In the second part of the talk, our recent results towards efficient single-photon detectors based-on semiconductor nanowire p-n junction arrays operating at room temperature will be presented. Due to the unique nanowire shape and device design, we achieve broadband high-efficiency photodetection from the UV to the near infrared with peak efficiencies exceeding 80%. Such capability is beneficial for numerous applications including remote sensing of low power signals, acquiring high resolution images at long range and quantum communication, and advantageous for sensing applications requiring portability.

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