Fabrication technology for high-performance superconducting nanowire single-photon detectors

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Single-photon detection is a crucial technology for a vast range of scientific applications, from quantum information science to deep-space optical communication, biomedical imaging, and remote sensing. In recent years, superconducting nanowire single-photon detectors (SNSPDs) have emerged as a dominant counting technology for UV to near-infrared wavelengths, thanks to their low timing jitter, high efficiency, low dark counts, and the emergence of kilopixel-format arrays.

Recently, thanks to design and fabrication process improvements, we demonstrated SNSPDs with combined state-of-the-art performance in several reference metrics and pushed the single-photon sensitivity to mid-infrared wavelengths. In this paper, we describe the fabrication process at the foundation of our demonstrations. We provide a detailed overview of the several phases of the process, from substrate conditioning to detector packaging, with a particular focus on electron beam lithography. Finally, we discuss the correlation of our fabrication methods with the achieved performance metrics and trace a direction for further improvements.