Arrays of Superconducting Nanowire Single Photon Detectors for Imaging and Telecom applications.

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From quantum optics and secure telecoms to applications in laser ranging and life sciences, single photon detectors have become a major enabling technology. At the same time, Superconducting Nanowire Single Photon Detectors (SNSPDs) have become the technology of choice when it comes to sensing photons with high quantum efficiency, extremely low dark count rate, and precise timing of photon arrival [1, 2].

Traditionally, SNSPD devices are fabricated as a meandering line of 100 nm width patterned in a thin (5 nm) NbN or NbTiN film covering an area of 10 x 10 μm^2. Magnetron sputtering, commonly used for deposition of NbN and NbTiN films, has limitations in uniformity, hindering large-area device development. However, large area and multi-pixel SNSPDs require films with spatially uniform parameters such as thickness, superconducting transition temperature, and critical current

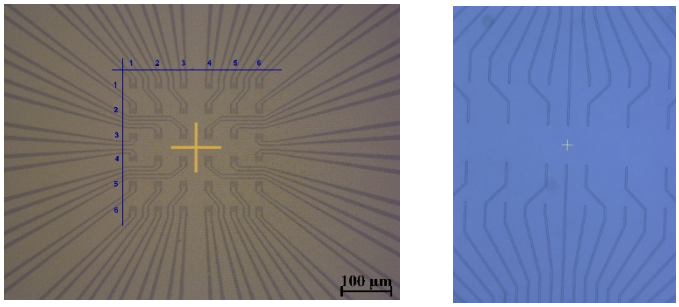

Figure 1. Optical micrographs of the 36- (left) and 80-pixel (right) SNSPD arrays.

density. Atomic Layer Deposition (ALD) is a newer technique that enables the production of high-quality thin films of NbN, TiN, and NbTiN [3]. Compared with sputtering, ALD provides improved film uniformity, enabling the fabrication of large-area SNSPD arrays with consistent performance across many pixels.

Here we report on the development of 36- and 80-pixel SNSPD arrays (shown in Figure 1) for applications in imaging with free-space coupling and in telecom with fiber-array multi-pixel optical coupling, fabricated using both sputtered and ALD superconducting films. We report on the design, cryogenic optical packaging, and performance of the arrays. We provide results from a study of the electrical, optical, and timing characteristics of individual pixels, as well as an analysis of the uniformity of these parameters across the arrays. We also present results of proof-of-concept experiments in quantum telecom and imaging using the fabricated SNSPD arrays.

References

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