NbN Nanowires for Single Photon Detectors

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Abstract. Single-photon detectors based on superconducting nanowires currently achieve an efficiency of over 90% in the infrared region [1,2] and thus have found numerous applications; ranging from quantum communication to deep-space communication and biomedicine. The superconducting wire in these detectors is fabricated from a thin film of disordered superconductors and typically has a width of 100 nm. The nanowire is current-biased near the critical current, and the absorption of a single photon disrupts the superconducting state. This results in a voltage pulse recorded by the readout electronics. The performance of these detectors strongly depends on the transport properties of the nanowire and on their optical properties. As the lateral dimensions of the nanowires are comparable to the coherence length of the superconducting films multiple phenomena, such as phase slips and hot spots are observable in their transport properties. The optical properties of the disordered superconductors in the metallic state, such as NbN and NbTiN, are also complex and the standard Drude model fails to describe them [3,4]. In this presentation, I will present the fabrication of NbN nanowires for the development of single-photon detectors. I will focus on their transport properties which were measured at temperatures down to 350 mK, and will discuss the optical properties of NbN films determined by spectroscopic ellipsometry.

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