Towards Large Area SNSPDs: MoN Thin Film Process Development

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Superconducting nanowire single-photon detectors (SNSPDs) are widely used in quantum communication, optical sensing, astronomical instrumentation and biological imaging due to their high detection efficiency, low dark count rates, and excellent timing resolution. Scaling SNSPD technology to large-area detectors and multi-pixel arrays, however, requires superconducting materials that maintain uniform properties in the ultrathin limit while enabling stable nanowire operation. Molybdenum nitride (MoN) is a promising material platform for SNSPDs due to its compatibility with ultrathin film deposition and favorable superconducting properties. Previous studies have demonstrated that MoN thin films exhibit uniform superconducting characteristics and SNSPDs made from them show saturated internal detection efficiency [1-2]. In addition, hotspot formation following photon absorption has been shown to be comparable to NbN films [3]. These characteristics make MoN particularly attractive for scalable SNSPD architectures.

In this work, we deposit MoN films with thicknesses down to ~2.4 nm by reactive magnetron sputtering while systematically varying the nitrogen fraction to tune film stoichiometry and electrical properties. Wafer-scale measurements demonstrate good sheet-resistance uniformity across a 4-inch wafer. A bulk Tc of 6.3 K was measured for these films. Microwire patterning was performed using electron-beam lithography with maN-2401 negative resist, which provides high-resolution pattern definition. In parallel, etch process development for MoN nanostructures is currently underway to establish reliable pattern transfer with minimal damage to the ultrathin superconducting films.

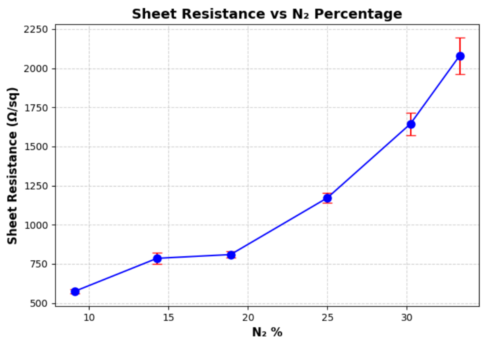

Fig. 1: *Sheet resistance vs Nitrogen content for MoN thin films.*

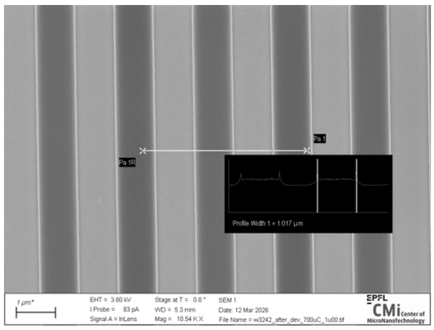

Fig. 2: *SEM image of 1 µm wide patterned resist using electron-beam lithography.*

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References

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