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Atomic Layer Deposition Niobium Nitride Films for High-Q Resonators

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Niobium nitride (NbN) is a useful material for fabricating detectors because of its high critical temperature and relatively high kinetic inductance. In particular, NbN can be used to fabricate nanowire detectors and mm-wave transmission lines. When deposited, NbN is usually sputtered, leaving room for concern about uniformity at small thicknesses. We present Atomic Layer Deposition niobium nitride (ALD NbN) as an alternative technique that allows for precision control of deposition parameters such as film thickness, stage temperature, and nitrogen flow. Atomic-scale control over film thickness admits wafer-scale uniformity for films 4-30 nm thick; control over deposition temperature gives rise to growth rate changes, which can be used to optimize film thickness and critical temperature. In order to characterize ALD NbN in the radio-frequency regime, we construct single-layer microwave resonators and test their performance as a function of stage temperature and input power. ALD processes can admit high resonator quality factors, which in turn increase detector multiplexing capabilities. We present measurements of the critical temperature and internal quality factor of ALD NbN resonators under the variation of various ALD parameters.

Less than 5 years of experience since completion of Ph.D

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