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Investigation of coherence of niobium-based resonators enabled by a fast-sealing microwave cavity

We present our recent work exploring the coherence of niobium-based superconducting devices, with a focus on two aspects. The first aspect is the role of the niobium and substrate surfaces. We use an approach for sample packaging where devices can be quickly isolated in vacuum after metal oxide removal, using a special purpose sealable microwave cavity. The second aspect is the role of film growth and design in quality factors of Nb planar resonators.

An important element of this work is the use of a 3D cavity that can be sealed and evacuated on the order of a few minutes. This technique has the potential to significantly reduce microwave loss by limiting the growth of metal oxides, compared to the common packaging approaches used in the field that expose the device to air for uncontrolled periods of time. The microwave properties of the hermetically sealed cavity were modelled using electromagnetic simulation software and validated through reflection measurements.

We will present the design of several types of structures, including lumped and distributed resonators, used to probe various contributions to loss, including surface and interface loss and quasiparticle losses. We will discuss our recent results on the fabrication and characterization of resonators.

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