

Sensing superconducting film loss via flip chip

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Primary CNF Tools Used: Heidelberg MLA 150 Maskless Aligner, DWL2000, PT770, ABM contact aligner, SC4500 Even-Hour Evaporator

Abstract:

Superconducting quantum circuits are a leading prospective platform for achieving quantum computation. One bottleneck is the low lifetimes of individual qubits, partially related to the microwave loss associated with the superconducting films. This project focuses on developing a benchmarking scheme that enables detecting the loss of different superconducting thin films (target film) without the involvement of the fabrication on the target film. The scheme is also capable of sensing specific losses in the metal-air interface and in the conductor itself (e.g., due to quasiparticles) before any fabrication steps are taken, thereby isolating these

losses in the ‘pristine’ state of the material. This serves as a useful benchmark for subsequent work testing devices after nanofabrication.

Summary of Research:

Sensing resonator: In this project, we use a high quality factor superconducting resonator (sensing resonator) to probe a target film. The sensing resonator is fabricated from niobium or tantalum thin films at CNF.

SU8 pillar: To sense the loss of the target film, the sensing resonator must be a few microns away from the target film, with an uncertainty less than half a micron. In this project, we use 4 μm SU8 pillar. The resist coating, exposure, and development are done in CNF as well.

Target film and measurement: The target film involved in this study includes SiO₂ layers on Nb films. The SiO₂ layers are deposited using the even-hour evaporator. Preliminary data shows a similar power-dependent quality factor as resonators deposited directly onto SiO₂. This is encouraging, as it indicates our novel approach will be able to sense any elevated losses in target films without exposing those films to fabrication processes.

Conclusions and Future Steps:

We developed a scheme combining SU8 and superconducting resonators for target film loss sensing. In the coming months, we will test different materials and share this technique to the community as a better platform to evaluate loss.

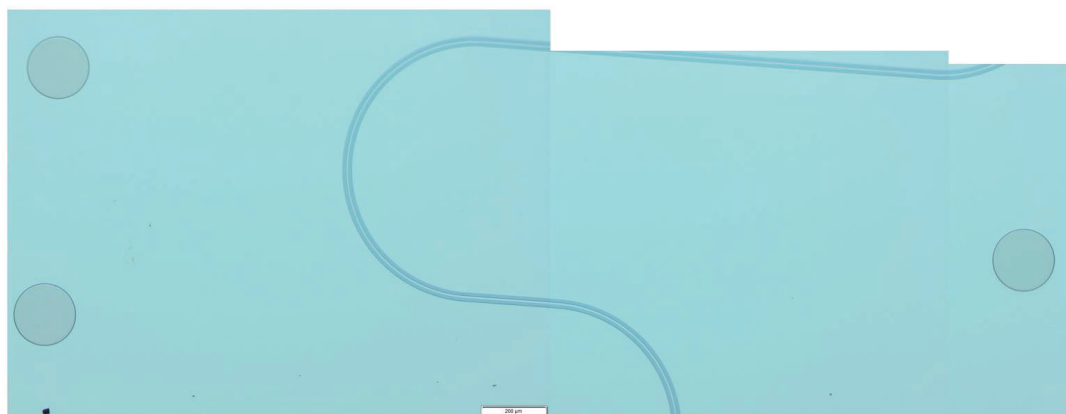


Figure 1: Resonator and pillar (partial).

