Superconducting Microwave Devices at the CNF

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Primary CNF Tools Used: Heidelberg DWL2000, ABM contact aligner, AJA sputterer, AJA ion mill, Glen 1000, Angstrom e-beam deposition, both JEOL systems

Abstract:

The Fatemi Lab is interested in a spectrum of nanodevice research ranging from low dimensional materials to quantum circuits, with a focus on superconductivity, including novel superconductors or device physics enabled by superconductors. In the last year we have advanced our capability in superconducting qubit and resonator fabrication, as well as in graphene Josephson junctions.

Summary of Research:

We have developed high quality resonators and Josephson junctions for superconducting microwave qubits. With the transmon qubit and readout resonator fabricated partially at CNF, we demonstrated a new quantum control protocol [1]. We are also leveraging these skills to investigate novel materials and fabrication methods for superconducting qubits, aiming for higher performance.

Additionally, in our graphene mesoscopic superconductivity efforts, we have recently found that Ti/Al contacts deposited by e-beam evaporation have much higher contact transparency than Ti/Nb contacts deposited by magnetron sputtering. This could be due to work function mismatch or interface damage. We are continuing to investigate improved contacts by leveraging this observation. Preliminary Josephson devices, both two- and multi-terminal have been successfully tested in our lab.

Conclusions and Future Steps:

We have developed useful qubit and graphene Josephson junction fabrication at the CNF. Moving forward, we anticipate development of superconducting qubits and other novel microwave-frequency devices based on novel materials and graphene Josephson devices.

References:

[1] https://arxiv.org/abs/2405.15695