

## Ta Based Damascene Resonators

The latest performance improvement in superconducting transmon qubits is associated to changes in materials and surface engineering. These approaches yield coherence time up to 0.5 milliseconds for Ta based devices, with Nb-based qubits following closely. This improvement is attributed to the oxidation state of Ta vs Nb, which effect the Two-Level-System (TLS) noise in associated devices. As such, studies focused on oxidation and surface treatment/engineering are ongoing to verify and further improve device performance by exploring losses in superconducting resonators. PNNL is collaborating with NY CREATES/SUNY Poly and BNL to study the effects of fabricating damascene Ta resonators in high-resistivity silicon substrates. We have recently characterized these resonators demonstrating a current best Q on the order of  $10^5$  at low power. We will discuss these results and the prospect for further improvements.

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