Contribution ID: **98** Type: **not specified**

Surface engineering by atomic layer deposition and heat treatment for 3D Niobium resonators for applications in superconducting qubits

Thursday 19 September 2024 11:15 (23 minutes)

"Superconducting radio frequency (SRF) resonators are newly being used in the quantum regime (at temperatures below 1 Kelvin) for integration into 3D quantum computing processing units. The motivation behind these new applications lies in the fact that SRF cavities offer a coherence lifetime that is 1000 times longer than other 2D qubit architectures and provide sensitivities that are orders of magnitude higher. Nonetheless, SRF cavities still suffer from dielectric losses arising from two-level systems (two-state defects) dissipations present in the native oxide layers that forms once the superconductor is exposed to air. In this context, we are testing an approach consisting in passivating the surface of Niobium with thin ALD-deposited oxide films followed by thermal treatments. This approach resulted in a significant reduction of TLS and a great enhancement of their quality factor at low fields [1]. In our talk, we will present cavity results from various surface engineering routes that have state-of-the-art quality factors (Q ˜ 1011 at low fields). Surface characterization such as XPS and TEM will also be discussed in order to correlate the changes in the quality factors with the chemical and structural aspects of the surface.

[1] Yasmine Kalboussi et al, Reducing two-level system dissipations in 3D superconducting Niobium resonators by atomic layer deposition and high temperature heat treatment. Applied Physics Letters, 2024, 124 (13), pp.134001. ⟨10.1063/5.0202214⟩. ⟨hal-04470953⟩"

Presenter: KALBOUSSI, Yasmine

Session Classification: Functional Layers -Synergies

Track Classification: Functional layers and synergies