

NitrAl: a new material for superconducting qubit applications

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Materials that naturally display a kinetic inductance of the order of nH/\square are known as **superinductors**. These materials can lead to the improvement of coherence times of superconducting quantum circuits by the combination of an enhanced impedance while introducing low loss [1]. Typical examples of such materials include **disordered superconductors** and **granular superconductors**. An illustrative and widely used case is granular aluminum (grAl) [2], which consists of an AlO_x matrix filled with pure Al grains. In this work, we present a new superconductor, **nitridized aluminum (NitrAl, in short)**. NitrAl displays similar properties as grAl, the main difference being the presence of nitrides over oxides, possibly enhancing quality when used in applications for quantum devices. Within the scope of our research, superconducting NitrAl thin films have been fabricated and characterized both at room temperature and low temperature for the first time, covering a wide range of resistivity, critical temperature and critical field [3, 4]. The obtained results reflect a strong sensitivity in the microscopic disorder either by varying the film thickness or by introducing a different amount of nitrogen during fabrication. In comparison to both bare aluminum and granular aluminum, NitrAl displays a clear enhancement of the superconducting critical temperature. These results position NitrAl as a promising

candidate to operate as a resilient superinductor in superconducting quantum hardware applications.

References

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- [2] Grünhaupt, L. et al., *Nat. Mater.* **18** (2019), 816-819.
- [3] Torras-Coloma, A. et al., *Supercond. Sci. Technol.* **37** (2024), 035017.
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Figures

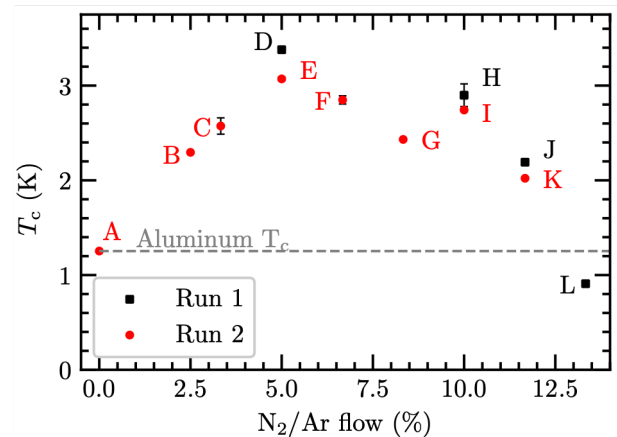


Figure 1: NitrAl critical temperature dependence on N_2 flow during fabrication.

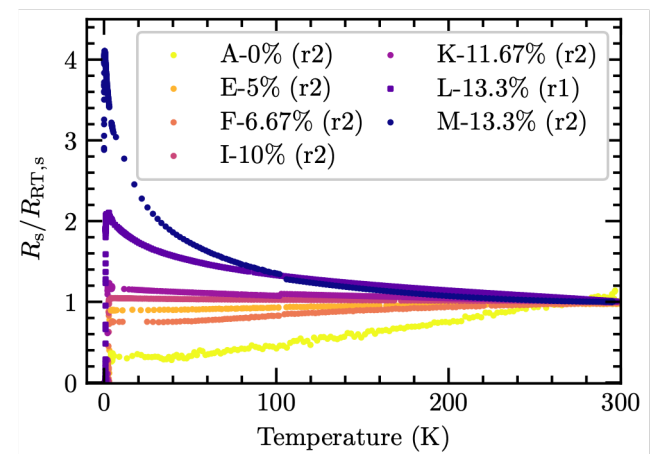


Figure 2: Superconducting transition curves of NitrAl thin films.