Thin-Film Deposition for Surface Characterization Studies for Superconducting Radio Frequency Cavity Application

CNF Project Number: 2779-19
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Primary Source(s) of Research Funding: The U.S. National Science Foundation under Award PHY-1549132, the Center for Bright Beams

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Primary CNF Tools Used: AJA Sputter Deposition 1 & 2

Abstract:

Superconducting radio-frequency (SRF) cavities are a key component of particle accelerators (with applications ranging from fundamental physics research to synchrotron X-ray sources, to e-beam microscopy and lithography) and are also being developed for applications in dark matter detection and quantum computing. We are developing next-generation surface treatments to enhance the performance of niobium superconducting surfaces. By using facilities at the CNF, we investigate the effect of metallic doping on the niobium surface. We highlight our recent success in growing Nb3Al and Nb-Zr superconducting alloys.

Summary of Research:

We used CNF's AJA sputter deposition tools to deposit zirconium on niobium samples for Nb-Zr alloy growth. This builds on our earlier development of a zirconium oxide capping layer recipe using the same CNF tool. We are still working to develop a recipe that achieves the optimal composition for superconducting performance. Additionally, we used the same tools to deposit aluminum on niobium samples for Nb3Al layer growth. We were able to verify the presence of Nb3Al on samples by Tc measurement and x-ray diffraction at CCMR.

Conclusions and Future Steps:

We prepared a large sample plate with Nb3Al, following the same recipe that was successful on small samples, and this sample plate has successfully been assembled into our RF testing setup for data collection. The results of this test will help guide future work on Nb3Al for SRF applications. In parallel, we will continue development of an Nb-Zr alloy recipe.

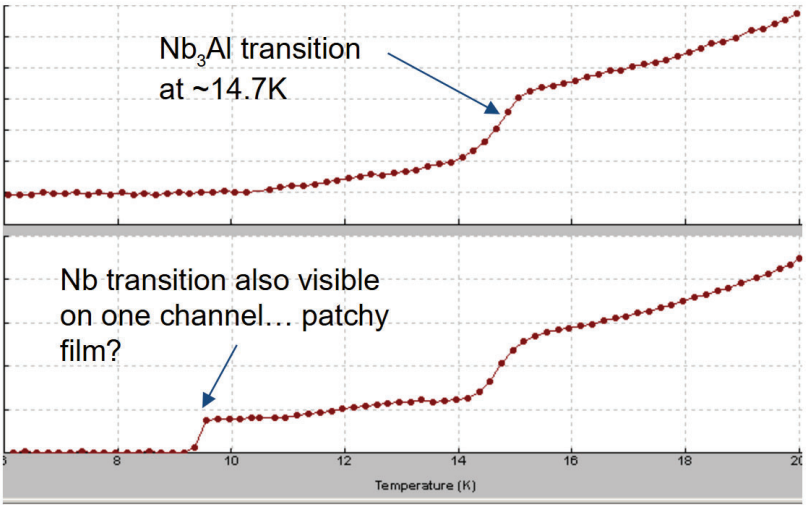

Figure 1: Resistance vs temperature data on first successful Nb3Al-on-Nb sample.