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Magnetic properties of niobium processed with high- and low-temperature nitrogen baking for SRF applications

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We systematically investigated the effects of various thermal treatments on the superconducting properties of niobium. In this study, niobium is utilized for fabricating nine-cell 1.3 GHz cavities used in particle accelerator facilities. Cylindrical niobium samples underwent the same chemical and thermal treatments applied to superconducting radiofrequency (SRF) cavities, including buffered chemical polishing (BCP), low-temperature baking (LTB), N-doping, and N-infusion. Magnetization curves and complex magnetic susceptibility were measured across a broad temperature range (2–9 K) and in dc magnetic fields up to 1 T. Bulk superconductivity parameters such as the critical temperature (Tc), thermodynamic critical field (Bc), and upper critical field (Bc2) were determined for samples subjected to different treatments. Notably, the Bc2 field exhibited significant variation depending on the treatment, reaching its highest value for N-doped niobium. Additionally, evidence of surface superconductivity at fields exceeding Bc2 was observed in all thermally treated samples, with the critical surface field surpassing the Ginzburg-Landau field in all cases.

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