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Superconducting Properties of Thin Film $\mathrm{Nb_{1-x}Ti_xN}$ Studied via the NMR of Implanted ^{8}Li

We present a study of the normal-state and superconducting properties of thin-film $\mathrm{Nb_{1-x}Ti_xN}$ using depth-resolved ^{8}Li β-detected nuclear magnetic resonance (β-NMR). Spin-polarized $^{8}\mathrm{Li}^{+}$ ions were implanted ~21 nm into a $\mathrm{Nb_{0.75}Ti_{0.25}N}$(91 nm)/AlN(4 nm)/Nb sample, with their NMR response recorded at temperatures between 4.6 K to 270 K under a 4.1 T field applied normal to the film surface. The resonance spectra exhibit broad, symmetric lineshapes at all temperatures, with additional broadening observed below the superconducting transition temperature $T_c \approx 15$ K attributed to vortex lattice formation. Lineshape broadening analysis yields the film's magnetic penetration depth λ and upper critical field B_{c2}, whose values are in good agreement with literature estimates. Spin-lattice relaxation (SLR) data reveal Korringa behavior at low temperatures, with thermally activated dynamics dominated above ~100 K. Below T_c, a small Hebel-Slichter coherence peak is observed, characterized by a 2.60 meV superconducting energy gap and modest Dynes-like broadening, consistent with strong-coupling superconductivity. These results provide a foundation for future studies of the Meissner-to-vortex transition in $\mathrm{Nb_{0.75}Ti_{0.25}N}$/AlN/Nb heterostructures, which is relevant for next-generation Nb superconducting radiofrequency (SRF) cavities (common components of particle accelerators).

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