Characterization of Sub-Micrometer Patterned Nb Thin Film for Superconducting Electronics on Ultra-Sensitive Mechanical Device

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Recently, Choi et al. suggested flux-quantum-based piconewton force measurement technique. In this technique, a micron-sized Nb superconducting ring with weak links on an ultra-thin silicon cantilever is a key device to realize quantized sub-piconewton force steps. For designing and analyzing such devices, Nb thin-film structure with precise definition of device parameters is necessary. In this work, we have characterized submicron-patterned Nb thin films which are prepared on silicon wafers and free-standing ultra-thin silicon bridges by dc magnetron sputtering and lift-off patterning with e-beam and photo lithography. The free-standing silicon bridges are beam shape, which is 460um long, 4um wide, and 0.34um thick, with a 30-um-wide paddle for mounting Nb superconducting circuit and a 20um-wide reflector for fiber optic interferometer. Superconducting characteristics such as transition temperature, critical current density, and voltage modulation of Nb strips and circuits were measured and their dependence on Nb film thickness and width were analyzed. More details will be discussed.

Keywords : Nb, superconductor, thin film, cantilever