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**True Josephson supercurrent in a Scanning Tunneling Microscope (STM) with a niobium tip and sample**[1] WAN-TING LIAO, J.R. ANDERSON, C.J. LOBB, F. WELLSTOOD, S.K. DUTTA, University of Maryland, College Park, MICHAEL DREYER, Laboratory for Physical Sciences — We have measured I-V characteristics of Josephson junctions formed between a Nb tip and a Nb surface in a 50 mK scanning tunneling microscope (STM). Depending on the distance between the tip and sample, which sets the normal state tunneling resistance $R_n$, the I-V characteristics are either in the phase-diffusion, underdamped or overdamped regime. For $R_n = 500$ kΩ the I-V curves show a quasiparticle current rise of 2 nA when biased at $V = 2\Delta/e$, but the junction is in the phase-diffusion regime and no supercurrent is visible at $V = 0$. For $R_n$ between 5 kΩ and 50 kΩ, the IV curves show a hysteretic switching response, as expected for an underdamped junction, and a true Josephson supercurrent at $V = 0$. For example, at $R_n = 5.95$ kΩ, the junction shows a quasiparticle current of 200 nA and a suppressed but true switching critical current of 15 nA. For $R_n < 1$ kΩ, the tunneling characteristics are those of an overdamped junction suggesting that the tip may be in physical contact with the surface, producing a weak link. In this regime at $R_n = 272$ Ω, the critical current is about 3 $\mu$A and is non-hysteretic. We extract and discuss key tunneling parameters (gap, capacitance and loss) in the different regimes.

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