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Current oscillations in ultra-small superconducting Nb-Nb junctions formed by STM at mK temperatures MICHAEL DREYER, ANITA ROYCHOWDHURY, RAMI DANA, University of Maryland — Using etched Nb STM tips we formed ultra-small tunnel junctions on a Nb crystal at an effective temperature of $\sim$ 200 mK using an Oxford dilution refrigerator. The Nb crystal was prepared in UHV and then transferred into the mK STM. The resulting superconductor-insulator-superconductor (SIS) junction displayed several sub-gap features from multiple Andreev reflections to a zero bias conductance peak. The latter showed features of a Josephson junction in the phase diffusion limit [2] with side structures due to the electrical environment [3]. Upon microwave irradiation the peak split into multiple peaks in accordance with theory [4], verifying Josephson tunneling. In addition we observed bias dependent oscillations of the tunneling current. The oscillations where recorded at a rate of 10 kS/s while acquiring conventional dI/dV or I(V) spectroscopic curves. Histograms of the current for each bias voltage step then reveal the nature of the oscillation. It ranges from multiple states in certain bias regions through pure oscillations to supercurrent-normal switching. Fourier transform of the current show in some cases a bias dependence of the main frequencies. Possible causes will be discussed.

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