A Scanning Tunneling Microscope for a Dilution Refrigerator

M. Marz* and G. Goll†

Physikalisches Institut, Karlsruher Institut für Technologie, 76131 Karlsruhe

H. v. Löhneysen

Physikalisches Institut and Institut für Festkörperphysik,

Karlsruher Institut für Technologie, 76131 Karlsruhe

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Abstract

We present the main features of a home-built scanning tunneling microscope that has been attached to the mixing chamber of a dilution refrigerator. It allows scanning tunneling microscopy and spectroscopy measurements down to the base temperature of the cryostat, $T \approx 30\,\mathrm{mK}$, and in applied magnetic fields up to 13 T. The topography of both highly-ordered pyrolytic graphite (HOPG) and the dichalcogenide superconductor $NbSe_2$ have been imaged with atomic resolution down to $T \approx 50\,\mathrm{mK}$ as determined from a resistance thermometer adjacent to the sample. As a test for a successful operation in magnetic fields, the flux-line lattice of superconducting $NbSe_2$ in low magnetic fields has been studied. The lattice constant of the Abrikosov lattice shows the expected field dependence $\propto 1/\sqrt{B}$ and measurements in the STS mode clearly show the superconductive density of states with Andreev bound states in the vortex core.

*Electronic address: Michael.Marz@kit.edu

†Electronic address: Gernot.Goll@kit.edu