Fluctuation conductance and the Berezinskii-Kosterlitz-Thouless transition in two dimensional epitaxial NbTiN ultra-thin films

K. Makise[a], H. Terai[a], T. Yamashita[a], S. Miki[a], Z. Wang[a], Y. Uzawa[b], S. Ezaki[c], T. Odou[c], and B. Shinozaki[c]

[a]National Institute of Information and Communications Technology, Kobe, Japan
[b]National Astronomical Observatory of Japan, Mitaka, Japan
[c]Department of Physics, Kyushu University, Fukuoka, Japan

We study on the electric transport properties of epitaxial NbTiN ultrathin films. The film thicknesses in this experiment ranged from 2 nm to 10 nm. The NbTiN films with thickness of 4 nm has mean-field superconducting transition temperature $T_{C0} = 9.44$ K. The excess conductance due to superconducting fluctuations was measured at temperatures near T_{C0}. At the low temperatures, the current-voltage characteristic shows a crossover from linear to nonlinear behavior. When the external magnetic field perpendicular to the film surface exceeds the upper critical field, logarithmic temperature dependence of resistance per square is observed at low temperatures, indicating that NbTiN films are nominally 2D in its normal conducting state. We find that there is a consistency between the parametrization of the 2D characteristics of fluctuation paraconductivity above T_{C0} and Berezinskii-Kosterlitz-Thouless type behavior below T_{C0}.