Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Direct Local Measurement of the Superconducting Energy Gap of Nb doped $SrTiO_3$ JEONGHOON HA, Center for Nanoscale Science and Technology/NIST, Maryland NanoCenter/UMCP, Natl High Magnetic Field Lab/FSU, GURU KHALSA, FABIAN NATTERER, Center for Nanoscale Science and Technology/NIST, HONGWOO BAEK, Center for Nanoscale Science and Technology/NIST, Dept.of Phys.and Astro./SNU, Natl High Magnetic Field Lab/FSU, WILLIAM G. CULLEN, Center for Nanoscale Science and Technology/NIST, Maryland NanoCenter/UMCP, YOUNG KUK, Dept.of Phys.and Astro./ Seoul Natl Univ., JOSEPH A. STROSCIO, Center for Nanoscale Science and Technology/NIST
— Strontium titanate (STO) is a perovskite metal oxide insulator that can be electron doped by substitution of Ti or Sr sites with Nb or La, respectively, or by oxygen vacancies. When doped to high electron densities with concentration in the range of $5x10^{19}$ cm^{-3} to $2x10^{20}$ cm^{-3}, STO becomes superconducting with a transition temperature below 400 mK, at a value highly dependent on the doping concentration. Previous observations were made on bulk crystals or films of doped STO by measuring the transitions in resistivity, magnetic susceptibility or thermal conductivity as a function of temperature or magnetic field. In this work, we use an ultra-low temperature scanning tunneling microscope(STM) to investigate the local electronic structure of the surface of Nb doped STO. The tunneling spectra taken at a sample temperature of ≈10 mK reveal a BCS energy gap of $\Delta = 40$ ueV. Temperature and magnetic field dependent tunneling measurements show a critical temperature of ≈250 mK and upper critical field of ≈0.07 T. This is the first report of direct measurement of superconducting STO using an STM.

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Date submitted: 05 Nov 2015 Electronic form version 1.4