Nanometer-scale superconducting domains observed on $NdBa_2Cu_3O_{7-\delta}$

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In understanding high temperature superconductivity, the recent focus is at the local-scale electronic modulation and its influence towards superconductivity in general. The results from $Bi_2Sr_2CaCu_2O_{8+\delta}$ samples are exciting and lead to a good deal of knowledge [1,2]. The granular structure and atomic-scale modulation of the density of states have been observed.

Here we report Scanning Tunneling Spectroscopic (STS) results obtained on the (*ab*) plane of a slightly underdoped $NdBa_2Cu_3O_{7-\delta}$ (T_c= 93.5 K) twinned single crystals at 4.2 K. Recent results proved that the NdBCO surface is highly clean and stable in air, showing atomic resolution at room temperature [3]. We used the STS imaging technique to study the electronic inhomogeneity and we observe that there are superconducting domains of ~ 3 nm length scale separated by nonsuperconducting regions, similar to that observed in $Bi_2Sr_2CaCu_2O_{8+\delta}$. In the superconducting domains, the size of the energy gap spatially varies from ~16 meV to ~44 meV. The average gap size is found to be ~22 meV. We discuss these data and the possible origin of the inhomogeneous electronic structure of the respective materials.

[1] Lang *et al.*, Nature **415,** 412 (2002)
[2] McElroy *et al.*, Nature **422,** 592 (2003)
[3] Ting *et al.*, Appl. Phys. Lett. **72,** 2035 (1998)