Scanning tunneling spectroscopy on (100) plane of $NdBa_2Cu_3O_{7-\delta}$

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Tunneling spectroscopy has been established to be an important tool to study the electronic structure of high-T_c superconductors (HTS). Though the focus initially was to study the energy gap size and gap structure, recently the scanning tunneling spectroscopy (STS) technique was used to obtain more useful informations like nanoscale inhomogeneity, charge ordering, spatial effect of impurities etc. which could not be obtained with any other technique at the local scale [1,2]. Here, we report the results of STS experiments performed on the (100) plane of $NdBa_2Cu_3O_{7-\delta}$ (NdBCO) single crystals (T_c = 95.5 K) at 4.2 K. From the dI/dV curves, which represents the local density of states (LDOS), we find a V-shaped curve with a very high conductance at the zero bias in the gap region which is typical in case of *d*-wave symmetry of the order parameter. In a region of 200 Å, we also observed other curves with very low coherence peaks or even with no peak structure, which is possible if the oxygen content is inhomogeneously distributed across the surface. A third type of curve, which is not frequently observed, has a peak at the zero bias conductance (ZBCP). We consider that the ZBCP is due to the Andreev reflection at the impurity potential (geometrically rough surface) and can be explained with the theory of roughness effect on the density of states of d-wave superconductor [3]. We can explain the data considering the symmetry order parameter to be $d_{x^2-y^2}$ wave, but at this moment we can not confirm if there is a mixing of any other component.

[1] Lang *et al.,* Nature **415**, 412 (2002).
[2] Pan *et al.,* Nature **403**, 746 (2000).
[3] Tanuma *et al.*, Phys. Rev. B**57**, 7997 (1998).