Highlights

Superconductivity - 2015

High-T_c Superconductivity at the Interface between the $CaCuO_2$ and $SrTiO_3$ Insulating Oxides

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At interfaces between complex oxides it is possible to generate electronic systems with unusual electronic properties, which are not present in the isolated oxides. One important example is the appearance of superconductivity at the interface between insulating oxides, although, until now, with very low T_c. We report the occurrence of high T_c superconductivity in the bilayer $CaCuO_2/SrTiO_3$, where both the constituent oxides are insulating. In order to obtain a superconducting state, the $CaCuO_2/SrTiO_3$ interface must be realized between the Ca plane of $CaCuO_2$ and the TiO_2 plane of $SrTiO_3$. Only in this case can oxygen ions be incorporated in the interface Ca plane, acting as apical oxygen for Cu and providing holes to the CuO_2 planes. A detailed hole doping spatial profile can be obtained by scanning transmission electron microscopy and electron-energy-loss spectroscopy at the O *K* edge, clearly showing that the (super)conductivity is confined to about 1–2 $CaCuO_2$ unit cells close to the interface with $SrTiO_3$. The results obtained for the $CaCuO_2/SrTiO_3$ interface can be extended to multilayered high T_c cuprates, contributing to explaining the dependence of T_c on the number of CuO_2 planes in these systems.

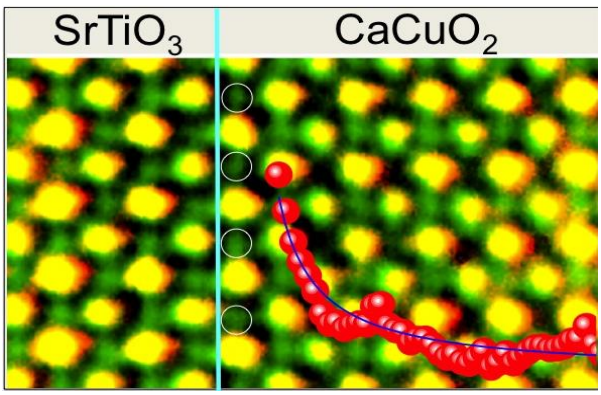

Figure: STEM image of the $CaCuO_2/SrTiO_3$ interface. The white circles indicate the excess oxygen ions at the interface Ca plane. The red bullets indicate the holes concentration decay on going far from the interface with $SrTiO_3$.