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$_3$. 