We report on the electronic reconstruction behind the hole doping mechanism in superconducting (SC) artificial superlattices (SLs) based on insulating CaCuO$_2$ (CCO) and SrTiO$_3$ (STO) blocks. Hard x-ray photoelectron spectroscopy (HAXPES) shows that the diverging built-in electrostatic potential arising at the polar/nonpolar CCO/STO interface is suppressed. However, the valence band alignment (Fig. 2(d)), calculated by the HAXPES core-level shifts, prevents any electronic reconstruction by direct charge transfer between CCO and STO bands.

A simplified mechanism for the suppression of the electrostatic potential can be based on a purely ionic mechanism, as shown in Fig. 1(b).

The oxygen compositional roughening, resulting from the proposed model, is supported by the presence of additional peaks and doublets in all the measured HAXPES core-level spectra.

Furthermore, by using highly oxidizing growth conditions, the oxygen coordination in the reconstructed interfaces may be increased by excess oxygen introduced at the interfaces. The charge neutrality is preserved by leaving two holes in the valence band of CCO for each extra oxygen ion, as shown in Fig. 2(d), thus making the cuprate block superconducting.