## **Supporting Information**

## Ionic liquid gating induced protonation of electron doped cuprate superconductors

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*Figure s1* (a) TOF-SIMS data showing the element selective intensities of a second 70-nm sample at different gating stages in sequence (left to right): pristine, gated at 1.3 V for 3 minutes and then gated at -0.3 V for 30 minutes. (b) Normalized intensity of H ions and <sup>18</sup>O ions at different gating stages in (a). The H (<sup>18</sup>O) intensity in LCCO is evaluated from the mean value in the region from z=20 to 50 nm [indicated by the vertical dashed lines in (a)]. The H (<sup>18</sup>O) intensity in the STO substrate is the mean value in the region of z>145 nm.



*Figure s2* (a) TOF-SIMS data showing the element selective intensities of three 50-60 nm thick samples (left to right): pristine, gated at 1.6 V for 8 minutes and gated at 1.6 V for 60 minutes. (b) Normalized intensity of H ions and <sup>18</sup>O ions at different gating stages in (a). The H (<sup>18</sup>O) intensity in LCCO is evaluated from the mean value in the region from z=20 to 40 nm. The H (<sup>18</sup>O) intensity in the STO substrate is the mean value in the region of z>85 nm.