

## Supplemental Information

### Monte Carlo analysis of the oxygen knock-on effects induced by synchrotron X-ray radiation in the $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\delta}$ superconductor

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TABLE S1. Length (along z), thickness (along x) and width (along y) of the irradiated samples.

Sample	Length ( $\mu\text{m}$ )	Thickness ( $\mu\text{m}$ )	Width ( $\mu\text{m}$ )
WBAP13	701	13.55	1.59
WBAP14	750	5.10	1.40
WBVB05	700	8.20	0.51
WBVB10	710	7.20	0.45

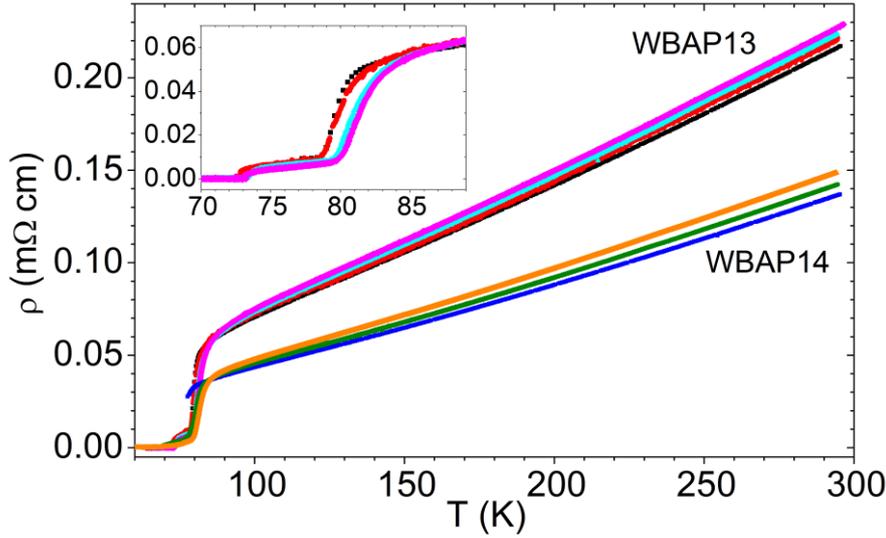


FIG. S1. Four-probe *ab*-plane resistivity versus temperature behaviors of sample WBAP13 in as-grown conditions (black), after the first dose ( $\Phi_{ph}=8.56\times 10^{20}$  cm<sup>-2</sup> and  $D=1.72\times 10^{11}$  Gy, red), the second dose ( $\Phi_{ph}=6.562\times 10^{21}$  cm<sup>-2</sup> and  $D=18.72\times 10^{11}$  Gy, cyan) and the third one ( $\Phi_{ph}=9.728\times 10^{21}$  cm<sup>-2</sup> and  $D=32.10\times 10^{11}$  Gy, magenta), and of sample WBAP14 in as-grown conditions (blue), after the first dose ( $\Phi_{ph}=3.946\times 10^{21}$  cm<sup>-2</sup> and  $D=16.41\times 10^{11}$  Gy, green) and the second one ( $\Phi_{ph}=7.413\times 10^{21}$  cm<sup>-2</sup> and  $D=25.90\times 10^{11}$  Gy, orange). The inset shows a blow-up of the transition region for sample WBAP13. Doses have been calculated as specified in Ref.S1.

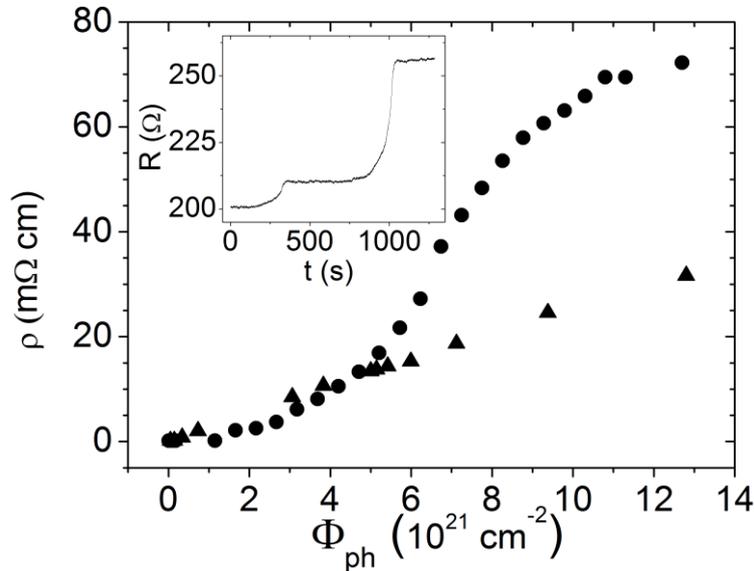


FIG. S2. Room temperature *ab*-plane resistivity  $\rho$  versus photon cumulative fluence  $\Phi_{ph}$  corresponding to samples WBVB05 (circles) and WBVB10 (triangles). The data were acquired during the irradiation sessions: a current of 5  $\mu$ A was set to pass through the crystals and the voltage drop was measured every 100 ms allowing to calculate the resistance of the sample while the beam was scanning the sample. The inset shows the typical time behavior of the sample resistance during irradiation, with the two non-constant sections corresponding to the completion of two subsequent irradiation rows.

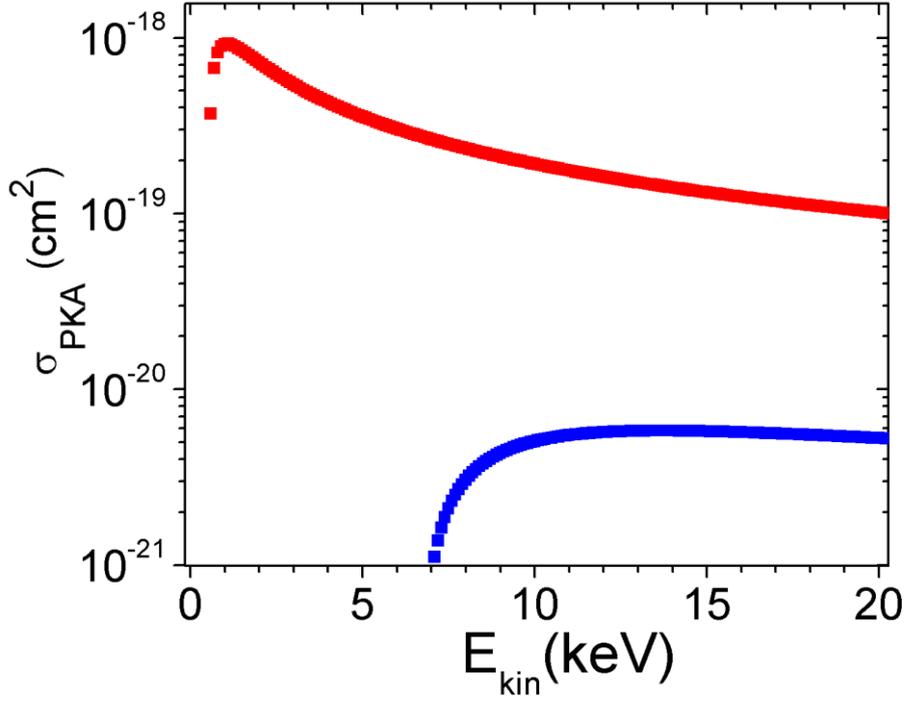


FIG. S3. Seitz-Koehler cross section  $\sigma_{\text{PKA}}$  versus electron kinetic energy  $E_{\text{kin}}$  curves for threshold displacement energies  $T_d = 0.93$  eV (blue) and  $T_d = 0.073$  eV (red). It is clear that the value of  $T_d$  is critical, since the cross section increases by more than one order of magnitude at 17 keV for  $T_d = 0.073$  eV compared to  $T_d = 0.93$  eV. Moreover, large differences can be observed in the minimum kinetic energy required for the electrons not to have zero cross section: they are equal to less than 1 keV and about 7 keV for  $T_d = 0.073$  eV and  $T_d = 0.93$  eV, respectively. Since lower energy electrons have a larger lateral spread (see Fig. 3), lower  $T_d$  values could be responsible for both an increase of the oxygen removal and for a decrease of the lateral resolution of the nanopatterning technique.

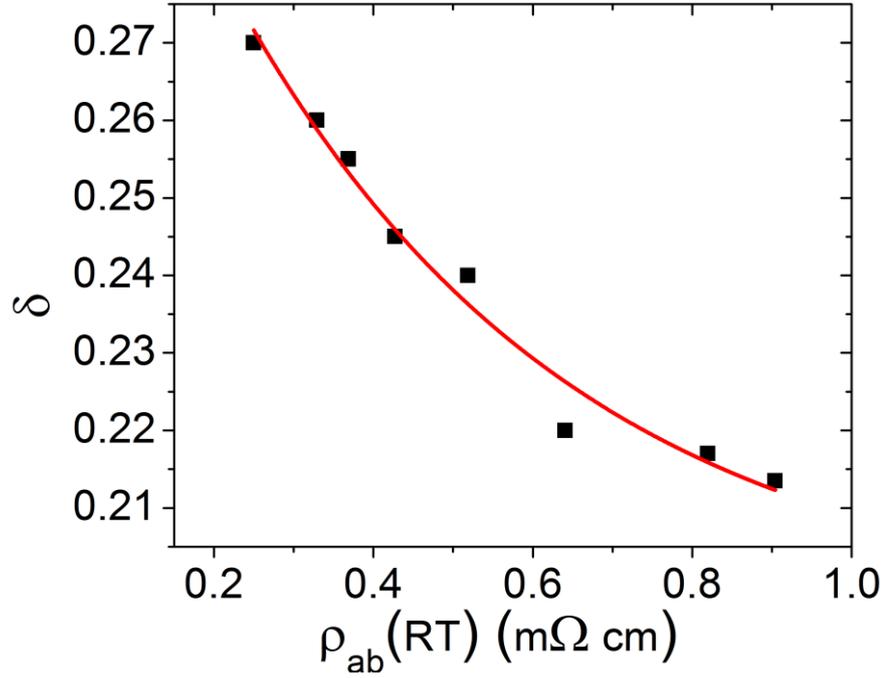


FIG. S4. Interstitial oxygen content  $\delta$  versus  $ab$ -plane resistivity at room temperature  $\rho_{ab}(RT)$  according to Ref. S2. The solid line represents a fit to the exponential function  $\delta = \delta_0 + A \exp(-\rho_{ab}(RT)/B)$ , where  $\delta_0 = 0.19589 \pm 0.0122$ ,  $A = 0.13590 \pm 0.0116$ ,  $B = (0.427768 \pm 0.13605)$  mΩ cm. R-square of the fit is 0.97206.

## References

- S1. A. Pagliero, L. Mino, E. Borfecchia, M. Truccato, A. Agostino, L. Pascale, E. Enrico, N. De Leo, C. Lamberti and G. Martinez-Criado, *Nano Lett.* **14** (3), 1583-1589 (2014).  
 S2. T. Watanabe, T. Fujii and A. Matsuda, *Phys. Rev. Lett.* **79** (11), 2113-2116 (1997).