

Supporting Information

Photonic Sintering of Copper through the Controlled Reduction of Printed CuO Nanocrystals

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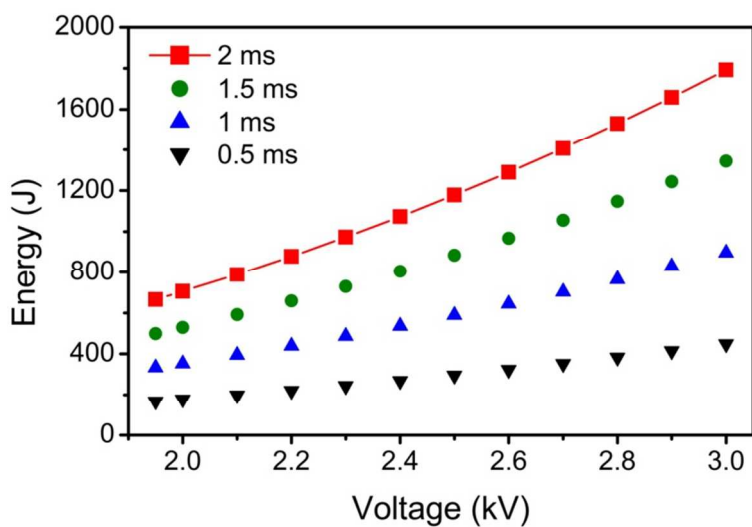


Figure S1. Energy delivered on the sample as a function of the applied voltage for different light pulse durations. The red line highlights the conditions adopted in this study.

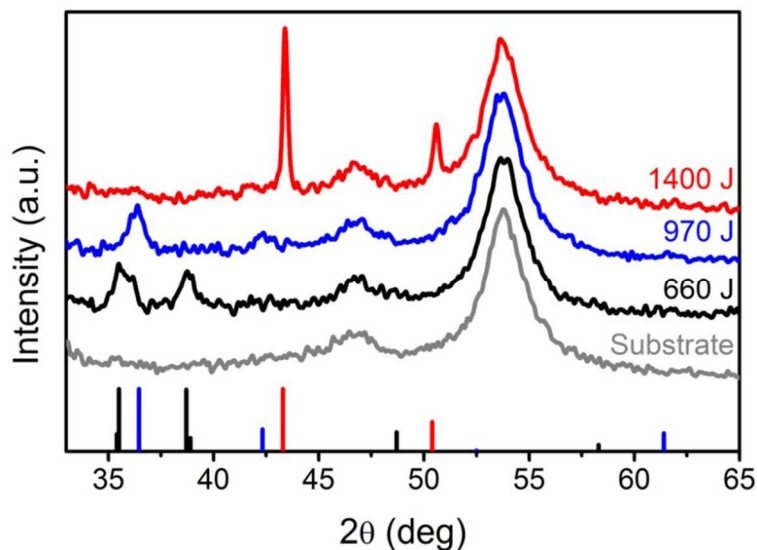


Figure S2. XRD patterns for CuO films subjected to IPL exposure of different energies deposited on Novele™ substrate. The diffraction pattern for the substrate is reported as well. The predicted peaks position for CuO (ICDD No. 48-1548, black), Cu₂O (ICDD No. 05-0667, blue) and Cu (ICDD No. 04-0836, red) are reported at the bottom.

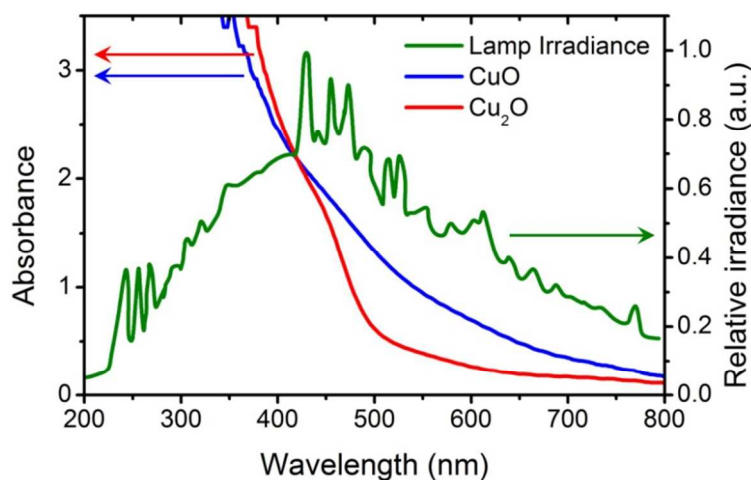


Figure S3. Emission spectrum of the xenon flash lamp and comparison with the absorption spectrum of CuO and Cu₂O films.

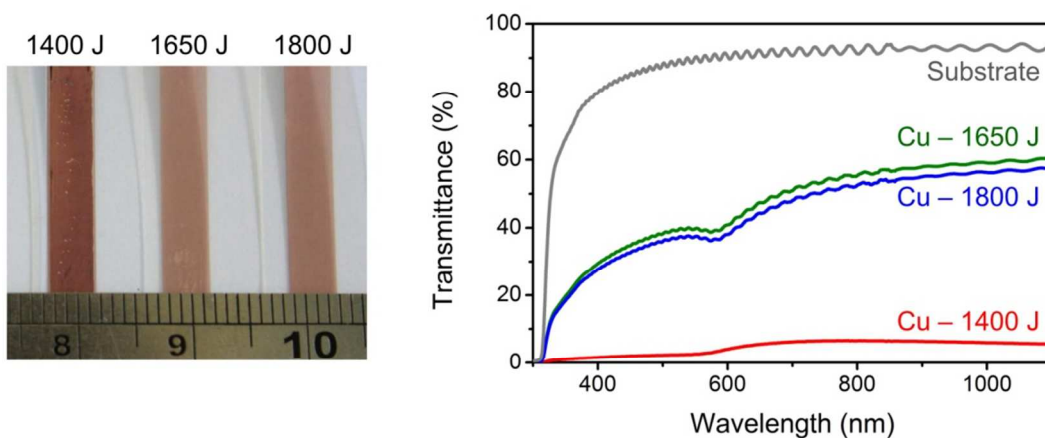


Figure S4. Digital picture (left) and transmission spectra (right) of Cu films properly sintered (pulse energy = 1400 J) and of Cu films exposed to excessive light energy (1650-1800 J). The overexposed samples are not conductive and show a higher transmission due to the loss of copper through vaporization and delamination. The small circular marks on the sample on the left are due to the tips of the 4-point probe used for the electrical measurements.

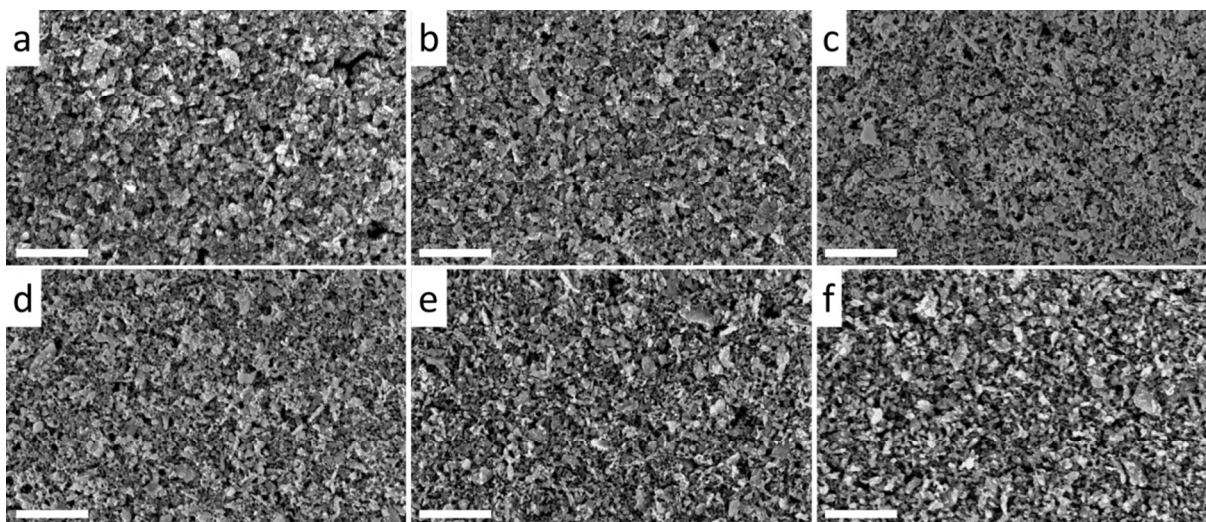


Figure S5. SEM characterization of the CuO coatings exposed to different energies of IPL: as deposited (a); 790 J (b); 880 J (c); 970 J (d); 1070 J (e); 1180 J (f). All scale bars are 500 nm.

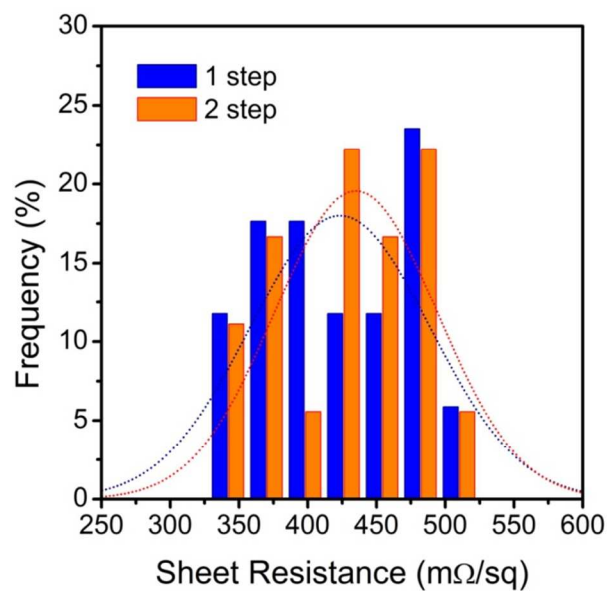


Figure S6. Distribution of sheet resistance values for samples sintered using one single light pulse at 1400 J (1 step) or 2 light pulses (970 J + 1400 J, 2 step). The dashed lines are the Gaussian fit of the histograms. No significant differences in resistivity can be seen using the two different IPL exposure protocols.

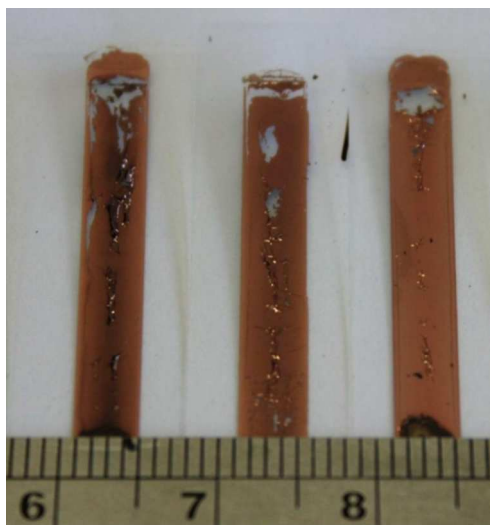


Figure S7. Digital picture of thick films exposed to one single high energy pulse showing massive delamination and blow-off problems. Incomplete reduction of copper oxide to copper metal can be also noticed from the dark color emerging from underneath the sintered layer.

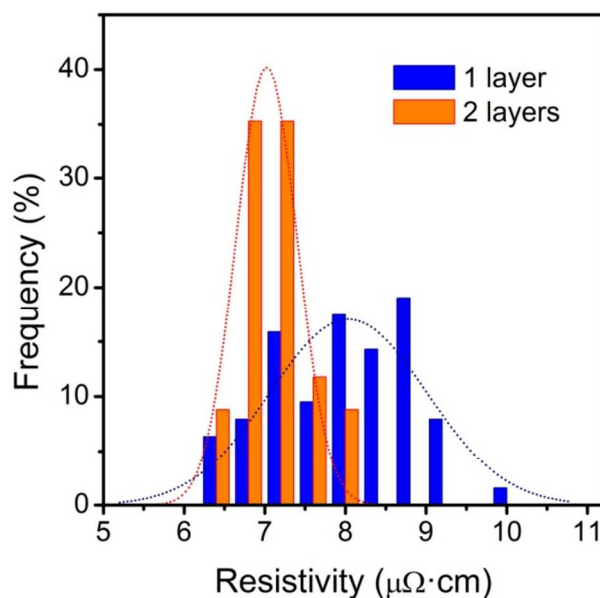


Figure S8. Distribution of resistivity values for samples prepared from 1 layer or from 2 layers of CuO NCs. The dashed lines are the Gaussian fit of the histograms.

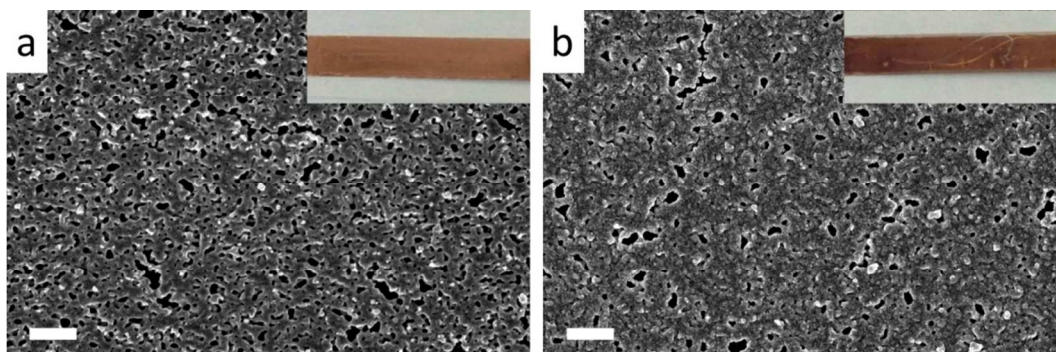


Figure S9. SEM images of Cu samples right after IPL exposure (a) and after prolonged exposure to ambient air (b). The scale bar is 1 μm in both panels. The insets show digital pictures of the samples. The re-oxidation of Cu in air causes a darkening of the films and the formation of a rougher and more faceted surface, as can be seen in (b).

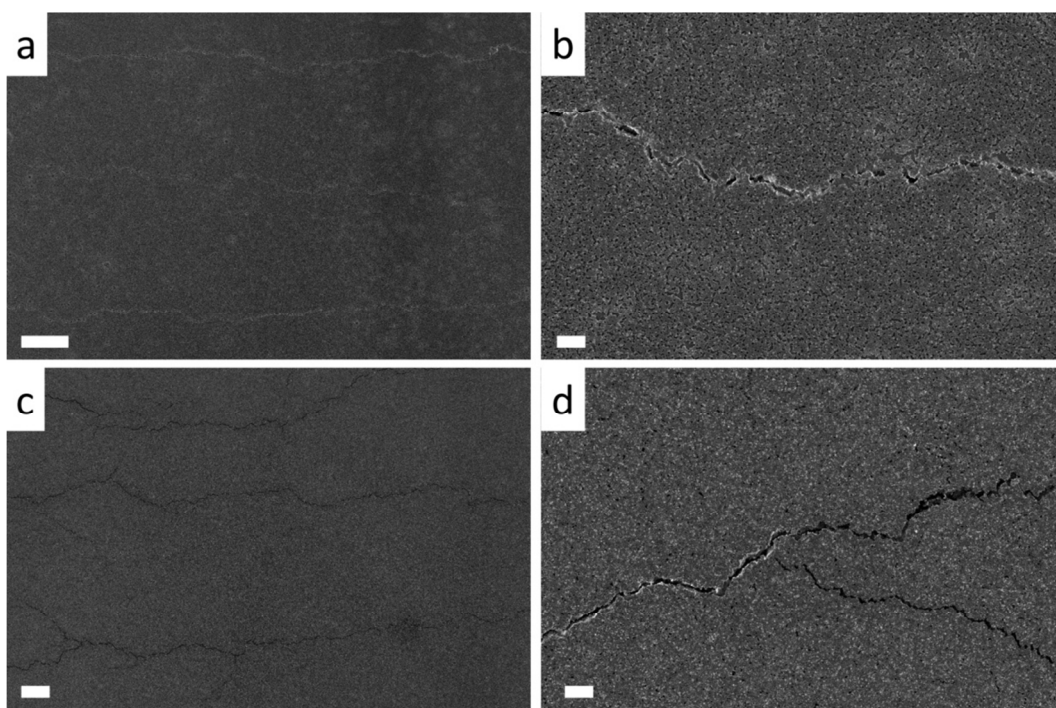


Figure S10. SEM images of Cu samples after 100 bending cycles showing the crack formation. (a,b) 1 layer, with linear parallel cracks; (c,d) 2 layers, with branched cracks. The scale bars are 20 μm in (a,c) and 2 μm in (b, d).



Figure S11. Picture of a sintered Cu strip with evaporated Ag contact pads used for long-term stability measurements and bending tests.