

# Light-Driven Tuning of Ultra-Thin Gold Films by Photoreduction

*Daniel Martínez-Cercós<sup>1,\*</sup>, Bruno Paulillo<sup>1</sup>, Jessica Barrantes<sup>1</sup>, Jose Mendoza-Carreño<sup>2</sup>, Agustín Mihi<sup>2</sup>, Todd St. Clair<sup>3</sup>, Prantik Mazumder<sup>3</sup>, Valerio Pruneri<sup>1,4,\*</sup>*

<sup>1</sup>ICFO-Institut de Ciències Fòniques, The Barcelona Institute of Science and Technology, 08860 Castelldefels, Barcelona, Spain

<sup>2</sup>Institute of Materials Science of Barcelona ICMAB-CSIC Campus UAB, 08193, Bellaterra, Spain

<sup>3</sup>Corning Research and Development Corporation, Sullivan Park, Corning, 14831 New York, United States

<sup>4</sup>ICREA-Institució Catalana de Recerca i Estudis Avançats, Passeig Lluís Companys, 23, 08010 Barcelona, Spain

## Supporting Information

## 1. XPS spectrum of the O(1s) band of a 3 nm Au UTMF after O<sub>2</sub> plasma

In Figure S1 we report the O(1s) scans using X-ray photoelectron spectroscopy (XPS) of a 0.5 nm CuO seeded Au UTMF on a high purity fused silica (HPFS) substrate, previously exposed to an O<sub>2</sub> plasma (see Methods of main manuscript). The O(1s) main peak in the XPS O(1s) band spectrum can be fitted by two different gaussian peaks centered at 529.8 and 531.6 eV, which can be attributed to Au oxidation states Au<sub>2</sub>O<sub>3</sub> and Au(OH)<sub>3</sub>, respectively.<sup>1</sup>

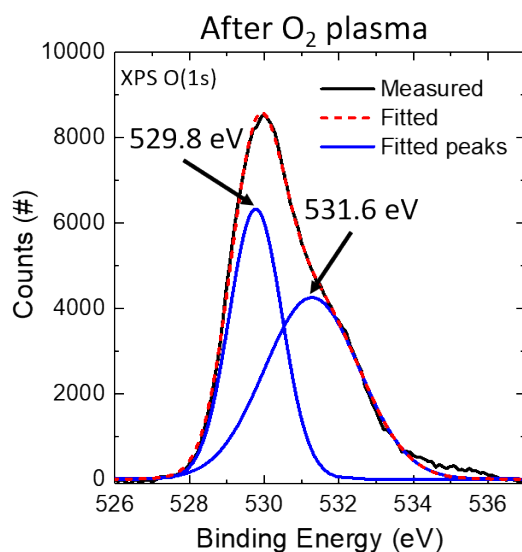


Figure S1. Measured (black continuous) and fitted (red dashed) O(1s) scans using X-ray photoelectron spectroscopy (XPS) of a 3 nm Au UTMF after exposition to O<sub>2</sub> plasma. The fitted curve has been demcomposed in two different smaller peaks with gaussian form (blue continuous). Characteristic O(1s) band XPS peaks corresponding to Au in the oxidation channels Au<sub>2</sub>O<sub>3</sub> and Au(OH)<sub>3</sub> at 529.8 and 531.6 eV, respectively, can be identified.<sup>1</sup>

## 2. AuO<sub>x</sub> reduction evolution without light irradiation

Figure S1 shows the relative  $R_S$  change over time in a controlled environment ( $T = 25\text{ }^\circ\text{C}$  and  $\text{RH} = 60\%$ ), of a previously  $\text{O}_2$  plasma exposed 3 nm Au UTMF in the absence of light irradiation from an external source. Sample  $R_S$  before (as-deposited) and after  $\text{O}_2$  plasma values are  $R_S(i) = 77.3\text{ }\Omega/\text{sq}$  and  $R_S(\text{O}_2) = 146.9\text{ }\Omega/\text{sq}$ , respectively. After 3 days, the relative change is -11%. This change can be attributed to the natural decomposition of the superficial oxide layer in the sample.<sup>2</sup>

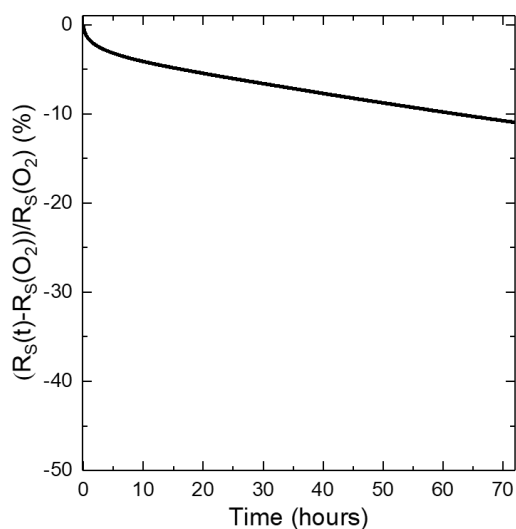


Figure S2. Evolution in the absence of direct illumination. Relative change of  $R_S$  as a function of time in a controlled environment ( $T = 25\text{ }^\circ\text{C}$  and  $\text{RH} = 60\%$ ), of a previously  $\text{O}_2$  plasma exposed 3 nm Au UTMF.

## **Bibliography**

- (1) Vincent Crist, B. *Handbook of Monochromatic XPS Spectra*; Wiley, 2000.
- (2) Tsai, H.; Hu, E.; Perng, K.; Chen, M.; Wu, J. C.; Chang, Y. S. Instability of Gold Oxide Au<sub>2</sub>O<sub>3</sub>. *Surf. Sci.* **2003**, 537 (1–3). [https://doi.org/10.1016/S0039-6028\(03\)00640-X](https://doi.org/10.1016/S0039-6028(03)00640-X).