Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

The correlation between electrical conductivity and second-order Raman modes of laser-reduced graphene oxide

Bing Ma, Raul D. Rodriguez*, Alexey Ruban, Sergey Pavlov, Evgeniya Sheremet

Tomsk Polytechnic University, Lenina ave. 30, 634034, Tomsk, Russia

Table S1. The temperature thresholds for the removal of different oxygen groups in GO adapted from reference:[47]

Temperature	Group
~200 °C	Vaporization of water molecules
~200–600 °C	Removal of carboxyl groups
~800 °C	Removal of residual carboxyl and hydroxyl groups
~1000 °C	Removal of residual hydroxyl groups, and partial removal of the epoxide group and removal of aromatic C=C bonds, which corresponds to the 50 mW irradiation power

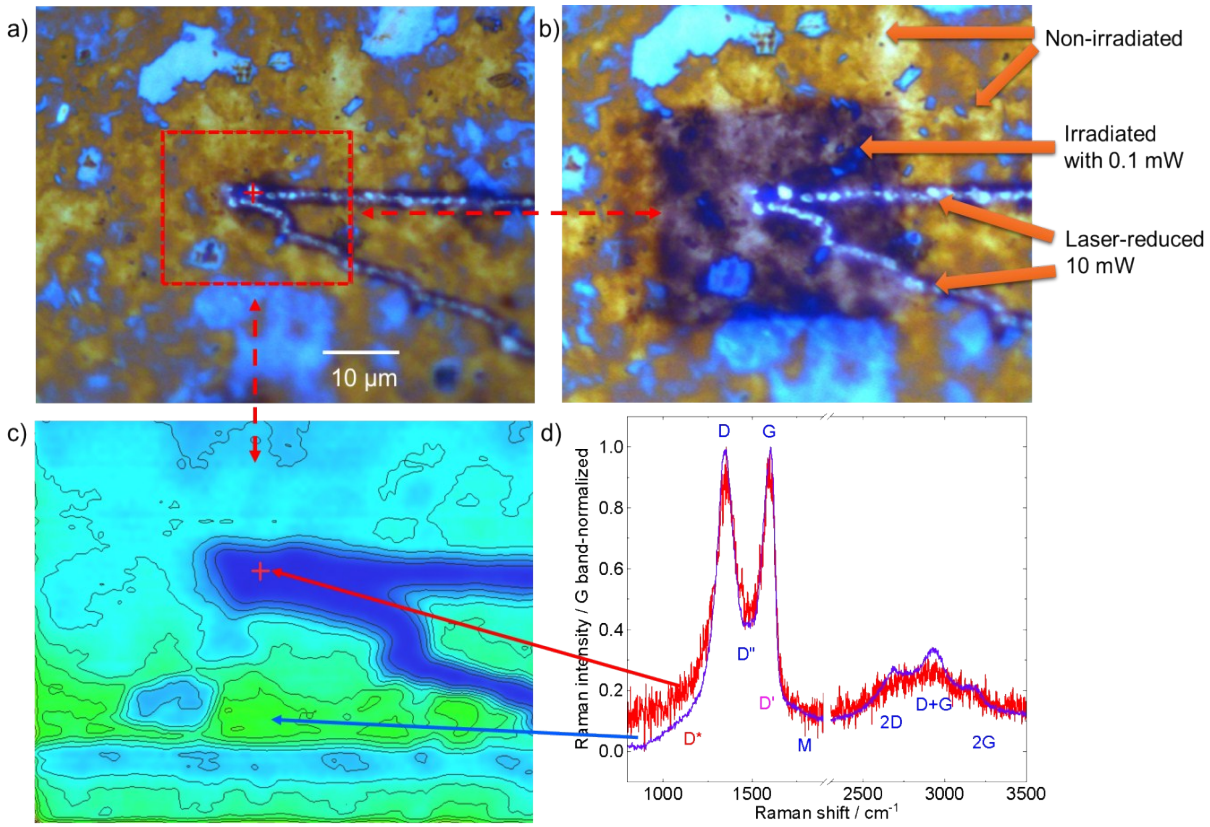


Figure S1. (a) Optical image of the pattern obtained at 10 mW before the Raman map. (b) Zoom out from the laser irradiated region after a Raman map at 0.1 mW laser power. (c) Raman map of the G band intensity with two representative spectra from laser-reduced and non-reduced regions shown by arrows in (d).

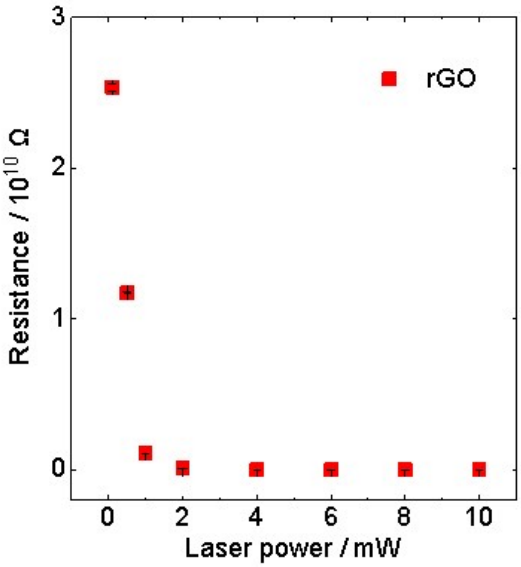


Figure S2. Linear plot of resistance of rGO *vs.* laser power

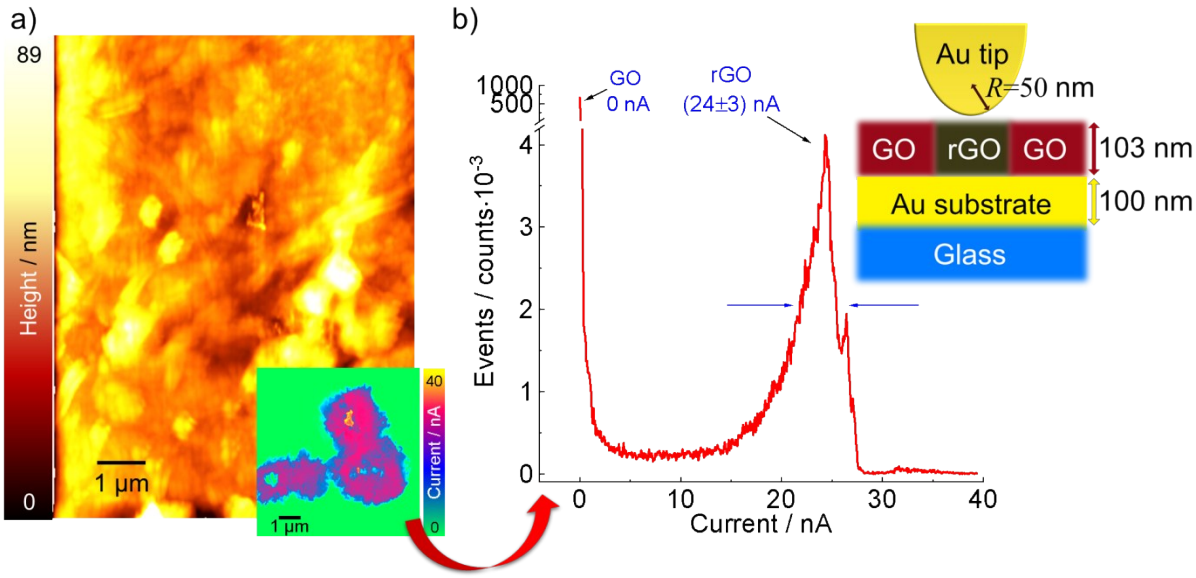


Figure S3. (a) The simultaneously-obtained topography image of the 8 mW laser-reduced rGO spot and the current image shown in the inset. The calculated RMS topography roughness is ca. 9 nm. (b) Histogram of the current image for the 8 mW rGO sample shown on the inset in b (and in Fig. 2d). The 0 nA current value reflects the insulator character of GO while the peak at 24 nA originates from the rGO spot conductivity with a half width of 3 nA. The inset in b shows the layer schematics of the sample with the different component sizes.

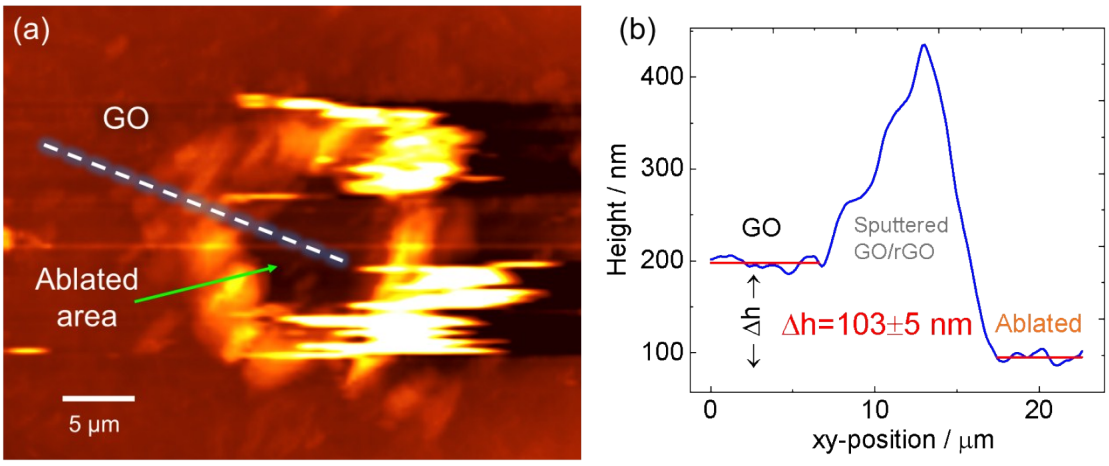
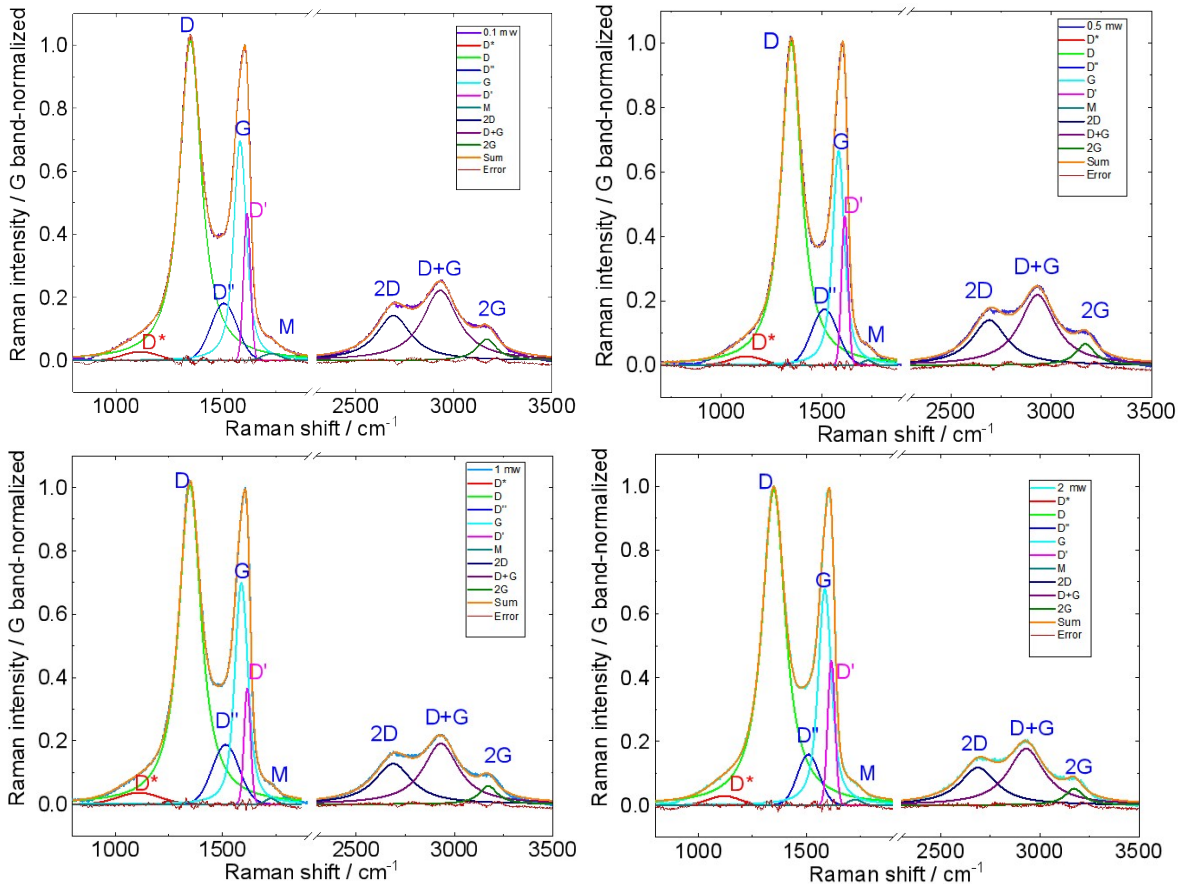


Figure S4. (a) Topography AFM image of a laser-ablated spot on the GO film on Au. (b) Estimation of the GO minimum thickness from a cross-section analysis from the AFM result shown in (a); the profile goes along the dashed line. The ablated region was made with a 405 nm laser and 1 W power in order to reduce the sputtering of material that resulted in the edges making AFM imaging unstable.



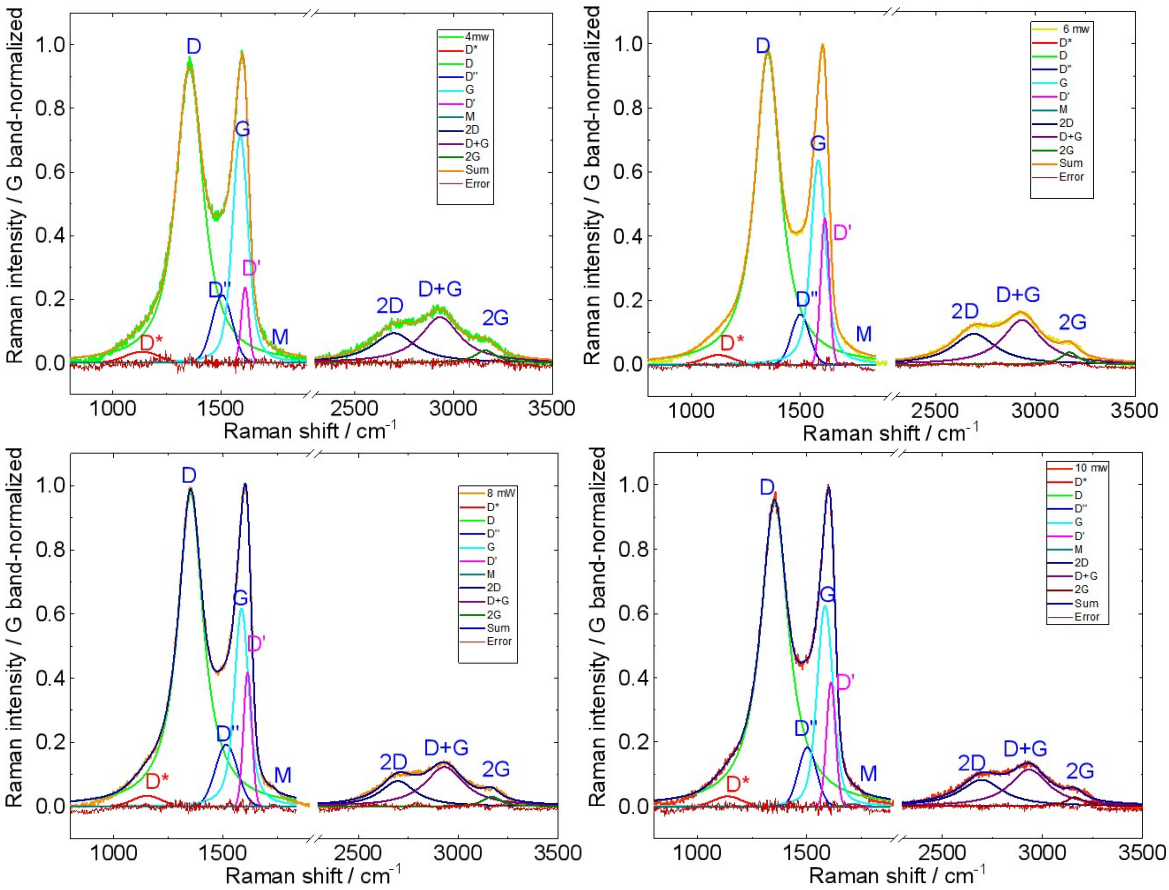


Figure S5. Raman spectra of rGO reduced with different powers

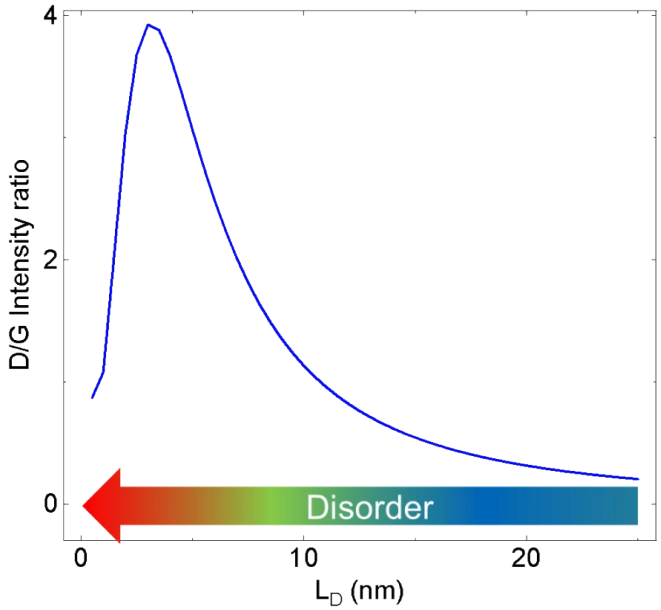


Figure S6. D / G ratio as a function of sp^2 domain size for the case of single layer graphene. Figure adapted from results reported in reference.[44]

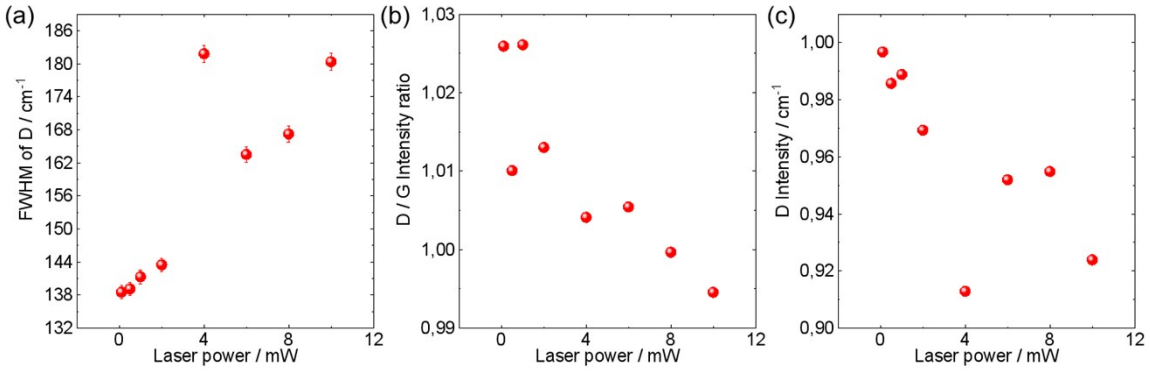


Figure S7. (a) D-FWHM of rGO *vs.* laser power. Notice that the D peak fitting for the GO sample reduced at 4 mW laser power shows a larger error which makes this point discontinuous in comparison to the other points obtained at any other laser power. (b) D/G ratio of rGO *vs.* laser power. (c) D band intensity *vs.* laser power