Scalable Fabrication of High-Performance and Flexible Graphene Strain Sensors —Supplementary Information

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This file includes:

1. Scalable fabrication of laser scribed graphene

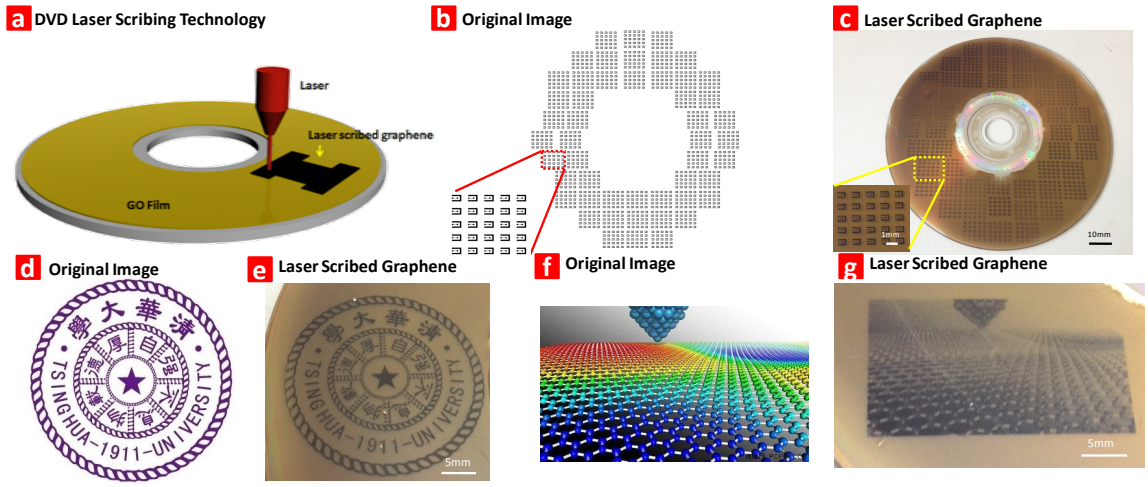

Figure S1 | Scalable fabrication of laser scribed graphene. (**a**) A schematic diagram showing the fabrication process of laser scribed graphene. A GO film is coated on a DVD media disc. The disc is inserted into a LightScribe DVD drive and a computer-designed circuit is etched onto the film. The laser inside the drive converts the golden-brown GO into black graphene at precise locations. The laser scribing technology makes it possible to obtain the large-area of precise graphene patterns in 25 minutes. (**b**) An original image of wafer-scale in-plane transistor patterns and (**c**) the same image reproduced by laser scribed graphene. (**d**) An original image of Tsinghua University logo and (**e**) the same image reproduced by laser scribed graphene. (**f**) A standard complex colored image of graphene and (**g**) the same image reproduced by reducing graphite oxide at various levels, which corresponds to a change in electrical properties.

2. XPS results of laser scribed graphene

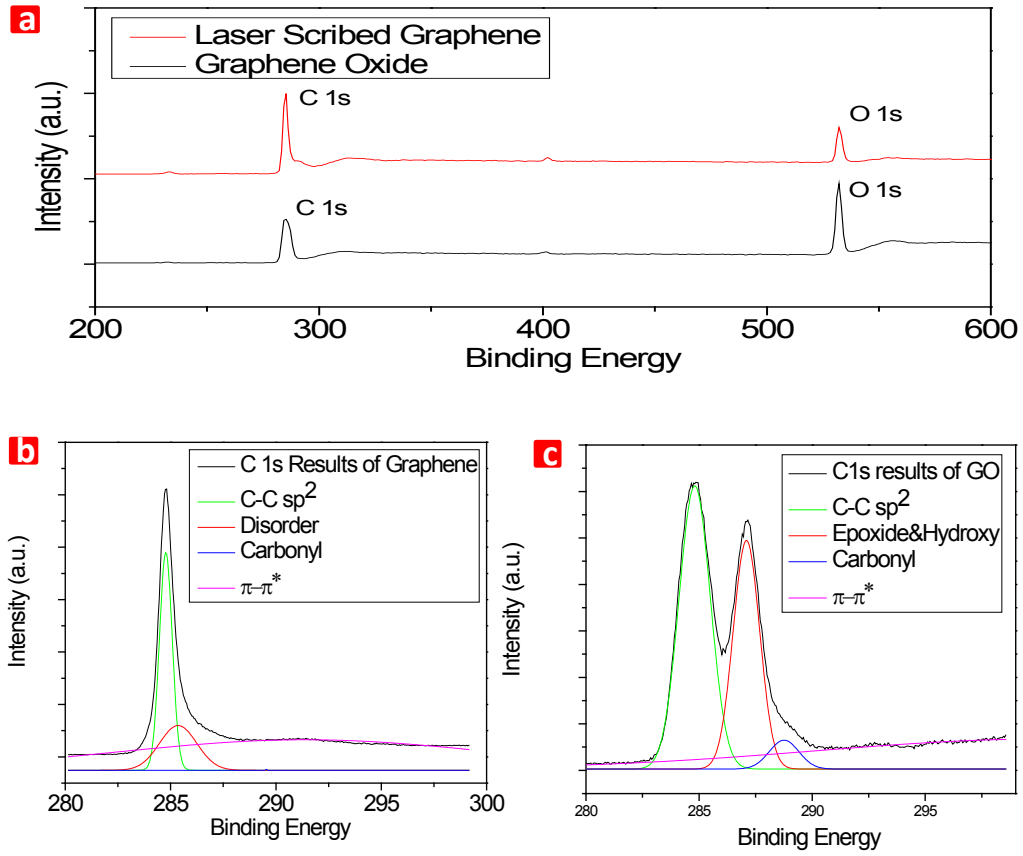

Figure S2. XPS Results of laser scribed graphene and graphene oxide. (a) Showing the full spectrum of the laser scribed graphene and graphene oxide. Compared with graphene oxide, it is indicated that oxygen is reduced significantly in laser scribed graphene. (b) C1s spectrum and fitting peaks of the laser scribed graphene. (c) C1s spectrum and fitting peaks of the GO film. Compared with graphene oxide, the C-C sp^2 and π-π* bonding enhanced significantly after reduction.

3. Raman results of laser scribed graphene

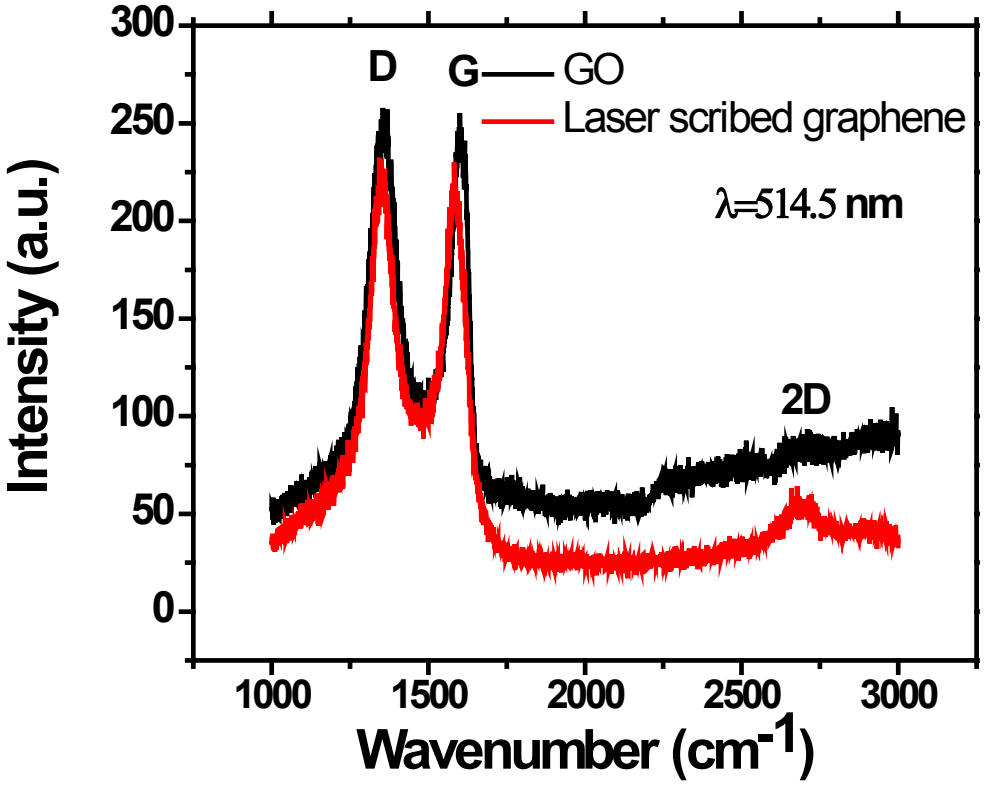

Figure S3. The Raman spectrum of the GO (black line) and laser scribed graphene (red line). It is demonstrated that the G band shift to smaller wavenumber, which is due to the reduction of oxygen functional group. Compared with GO, the increase in 2D band of laser scribed graphene indicates that few-layers graphene generated after laser irradiation.

4. Electrical results of laser scribed graphene

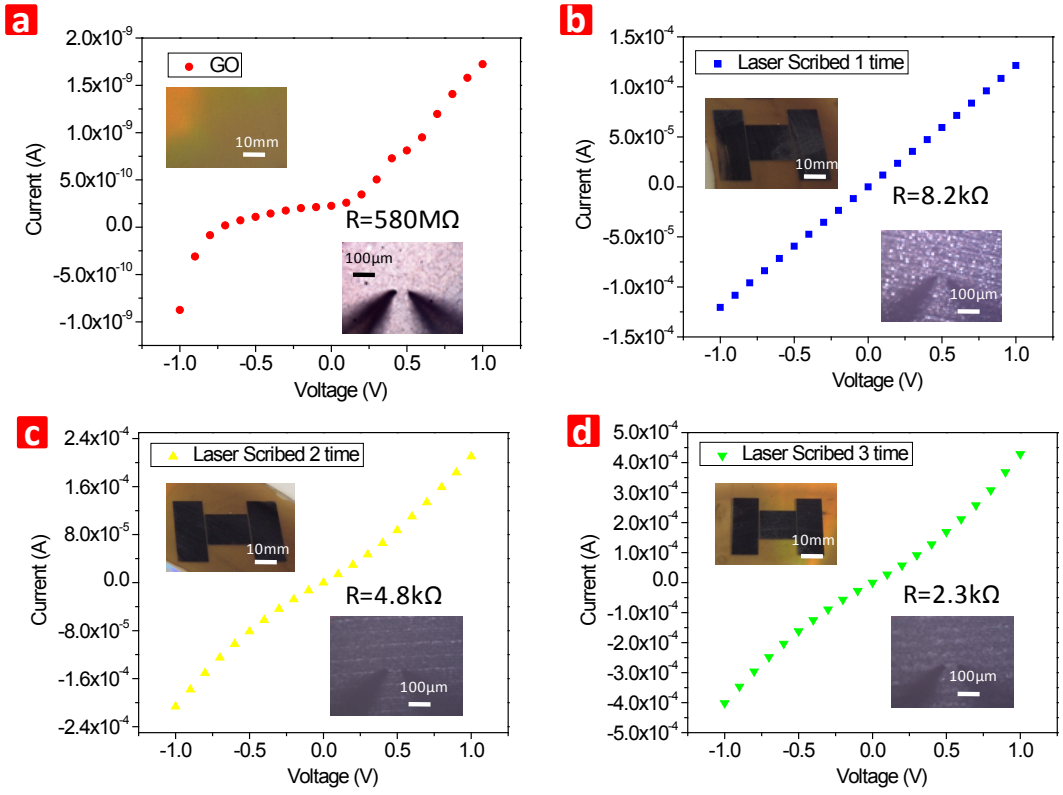

Figure S4. The electrical experimental results of the GO film and laser scribed graphene. (**a**) The I-V cure of GO film. The resistance is 580 MΩ, which could be regarded as an insulator. (**b**) The I-V cure of graphene after 1 time laser scribing. The resistance reduces to 8.2 kΩ significantly. (**c**) The I-V cure of graphene after 2 times laser scribing. The resistance is reduced to 4.8 kΩ. (**d**) The I-V cure of graphene after 3 times laser scribing. The resistance is reduced to 2.3 kΩ. Upper inset photograph showing GO film and laser scribed graphene after patterning 1 time, 2 times and 3 times respectively. Lower inset photograph showing two probes testing on the films.

5. Optical results of laser scribed graphene

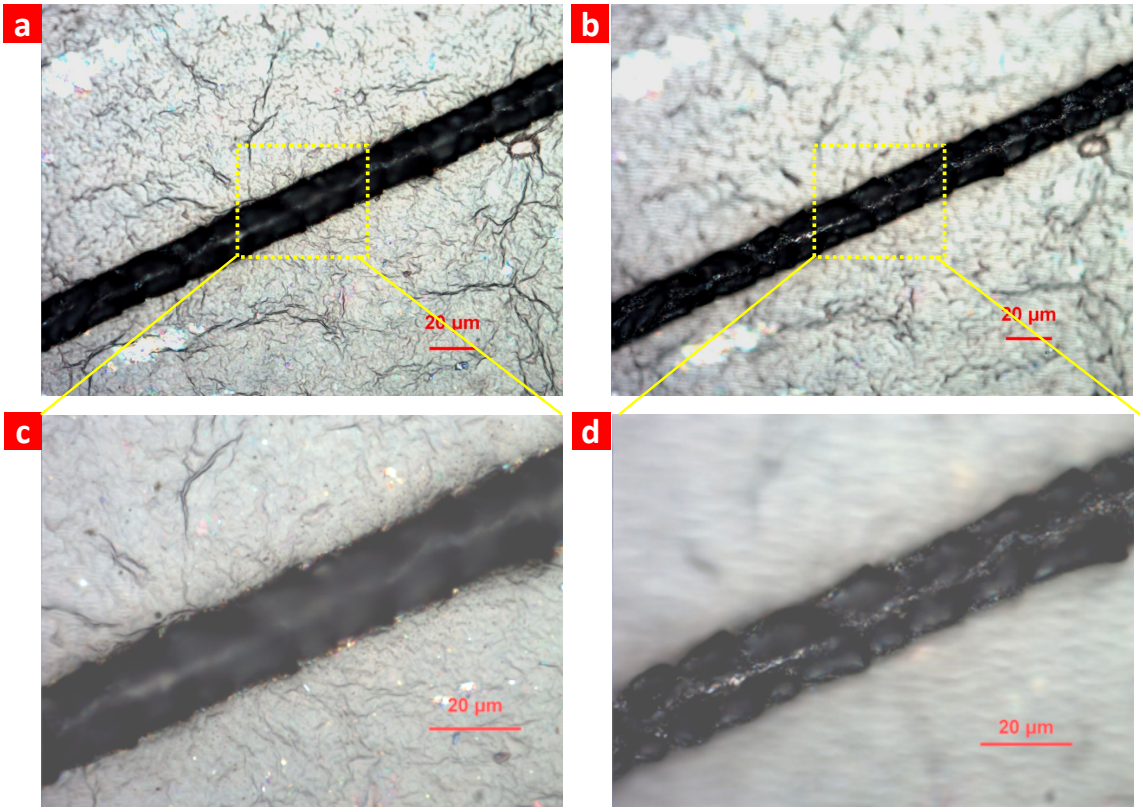

Figure S5. The laser scribed graphene microribbon with a minimum patterning resolution of 20 μm. (a) An optical image of laser scribed graphene microribbon under low magnification focused on the GO film. (b) An optical image of laser scribed graphene microribbon under low magnification focused on the laser scribed graphene. (c) A zoomed-in optical image of laser scribed graphene microribbon under high magnification focused on the GO film. (d) A zoomed-in optical image of laser scribed graphene microribbon under high magnification focused on the laser scribed graphene.

6. Endurance testing of the graphene micro-ribbon strain sensors

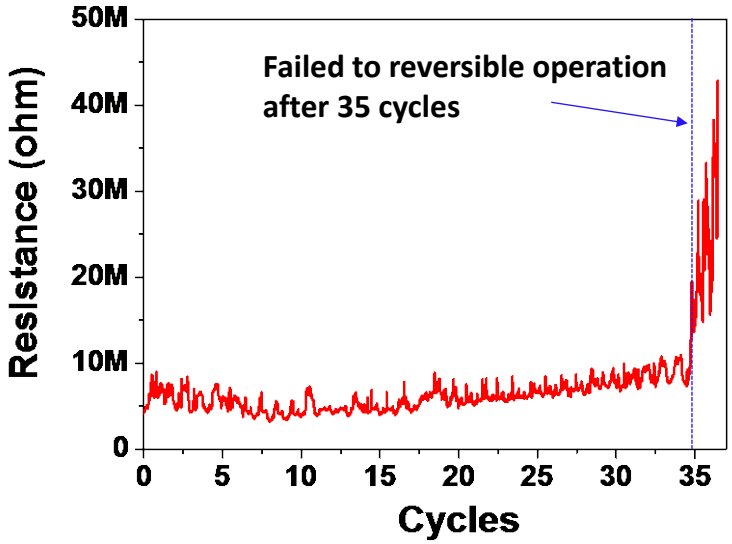

Figure S6. Endurance testing showing the graphene micro-ribbon strain sensors failed to reversible operation after 35 cycles. The resistance of graphene micro-ribbon increases over 400% due to the disconnecting of the carbon lattice boundaries.