Supporting information for

In Situ Monitoring of Electrical and Optoelectronic Properties of Suspended Graphene Ribbons during Laser-Induced Morphological Changes

Xiaosi Zhang[a], Thayer Walmsley[b], and Ya-Qiong Xu[a,b]*

[a]Department of Electrical Engineering and Computer Science, Vanderbilt University, Nashville, TN 37235, USA

[b]Department of Physics and Astronomy, Vanderbilt University, Nashville, TN 37235, USA

S1. Impact of Etching on Graphene Ribbons

We performed Raman spectroscopy measurements to inspect the quality of graphene during the fabrication process. As shown in Figure S1, the Raman spectrum of graphene on the substrate shows that the intensity of the 2D band (~2682 cm^{-1}) is ~1.7 times as high as that of the G band (~1584 cm^{-1}), indicating that the as-grown graphene is monolayer. After the wet etching process, the high 2D-to-G ratio (~1.8), the symmetric 2D band, and the small D band (~1350 cm^{-1}) suggest that the pristine quality of the graphene ribbon be maintained. There is no obvious split or shift observed in either G or 2D band, indicating that the graphene ribbon is under limited strain.[1-3]

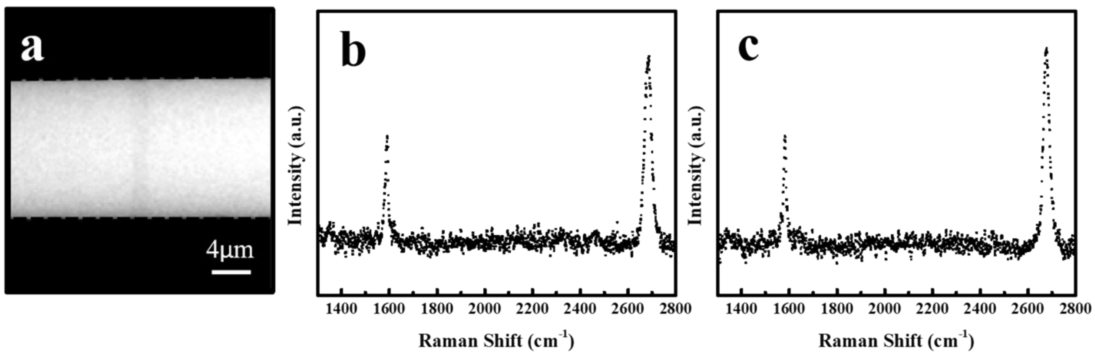

Fig. S1. (a) Optical image of a suspended graphene ribbon. Raman spectra of the graphene ribbon (b) before and (c) after the wet etching process under 532 nm illumination.

S2. Raman Spectroscopy Characterization of Folded Graphene Ribbons

Raman spectroscopy measurements were utilized to characterize the laser-induced morphological changes of a suspended graphene ribbon. As shown in Fig. S2, a suspended flat graphene ribbon has a strong symmetric 2D band with a 2D-to-G ratio of ~1.7, indicating that the graphene is of a monolayer structure. After an initial laser heating process, the 2D-to-G ratio of the laser heated region in the folded graphene ribbon I substantially reduced to ~1, suggesting a bi-layer or tri-layer folded structure was generated in this region. After further heating this region to form the folded graphene ribbon II, we have found that its 2D-to-G ratio is further decreased to 0.4, suggesting that multi-layer structures form.

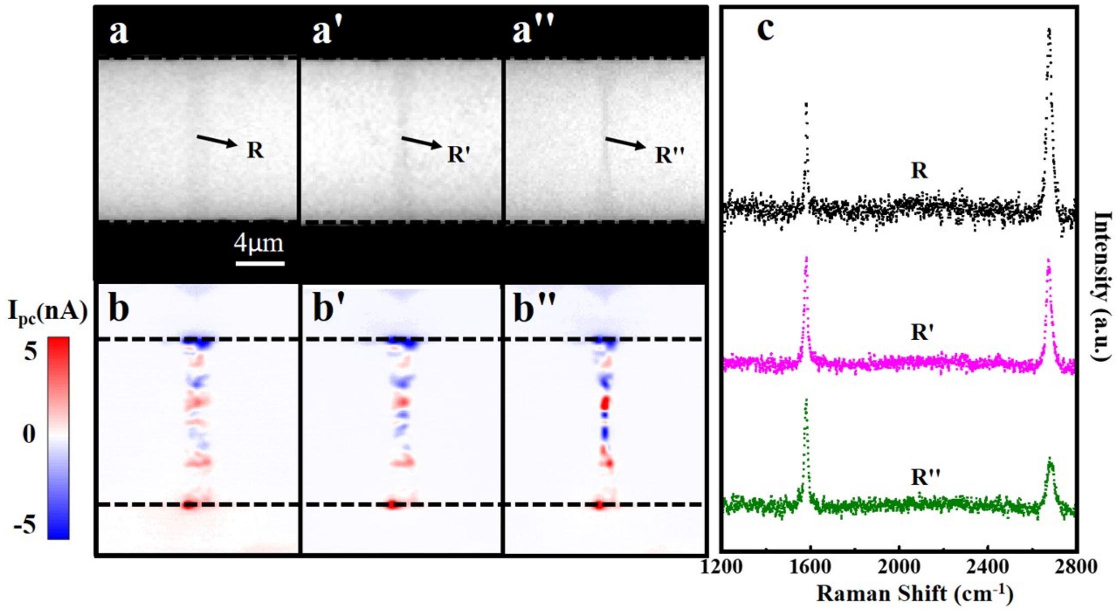

Fig. S2. (a) Optical and (b) photocurrent images of a suspended flat graphene ribbon. (a') Optical and (b') photocurrent images of the folded graphene ribbon I. (a'') Optical and (b'') photocurrent images of the folded graphene ribbon II. (c) Raman spectra of the suspended graphene ribbons with different morphologies.

S3. Laser-induced graphene conductance change

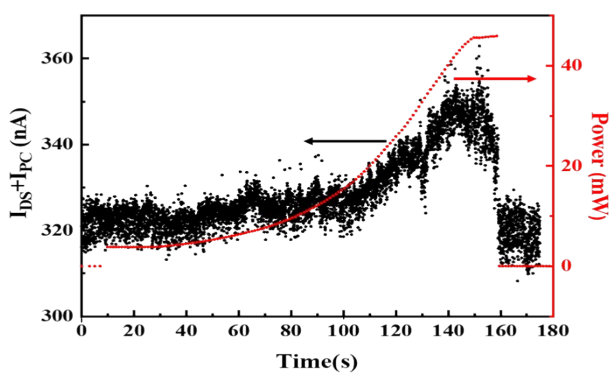

Fig. S3. The current of graphene (black) and the power of laser (red) as a function of time to examine the laser induced conductance change process. The 1064 nm laser beam is blocked when an abrupt current change is noted.

References

1. T. M. G. Mohiuddin, A. Lombardo, R. R. Nair, A. Bonetti, G. Savini, R. Jalil, N. Bonini, D. M. Basko, C. Galiotis, N. Marzari, K. S. Novoselov, A. K. Geim and A. C. Ferrari, *Physical Review B*, 2009, **79**, 205433.
2. A. C. Ferrari, *Solid State Communications*, 2007, **143**, 47-57.
3. D. Yoon, Y.-W. Son and H. Cheong, *Physical Review Letters*, 2011, **106**, 155502.