Electronic Supplementary Information

Chemically-Doped Graphene with Improved Surface Plasmon Characteristics: An Optical Near-field Study

Zebo Zheng,[ad] Weiliang Wang,[d] Teng Ma,[c] Zexiang Deng,[d] Yanlin Ke,[ab] Runze Zhan,[a] Qionghui Zou,[ad] Wencai Ren,[c] Jun Chen,[ab] Juncong She,[ab] Yu Zhang,[ab] Fei Liu,[ab] Huanjun Chen,[ab*] Shaozhi Deng,[ab*] Ningsheng Xu[ab]

[a.] † *State Key Laboratory of Optoelectronic Materials and Technologies, Guangdong Province Key Laboratory of Display Material and Technology, Sun Yat-sen University, Guangzhou 510275, China.*

[a.] School of Electronics and Information Technology, Sun Yat-sen University, Guangzhou 510006, China.

[b.] Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences, 72 Wenhua Road, Shenyang 110016, China.

[c.] School of Physics, Sun Yat-sen University, Guangzhou 510275, China

* Corresponding Authors: chenhj8@mail.sysu.edu.cn; stsdsz@mail.sysu.edu.cn

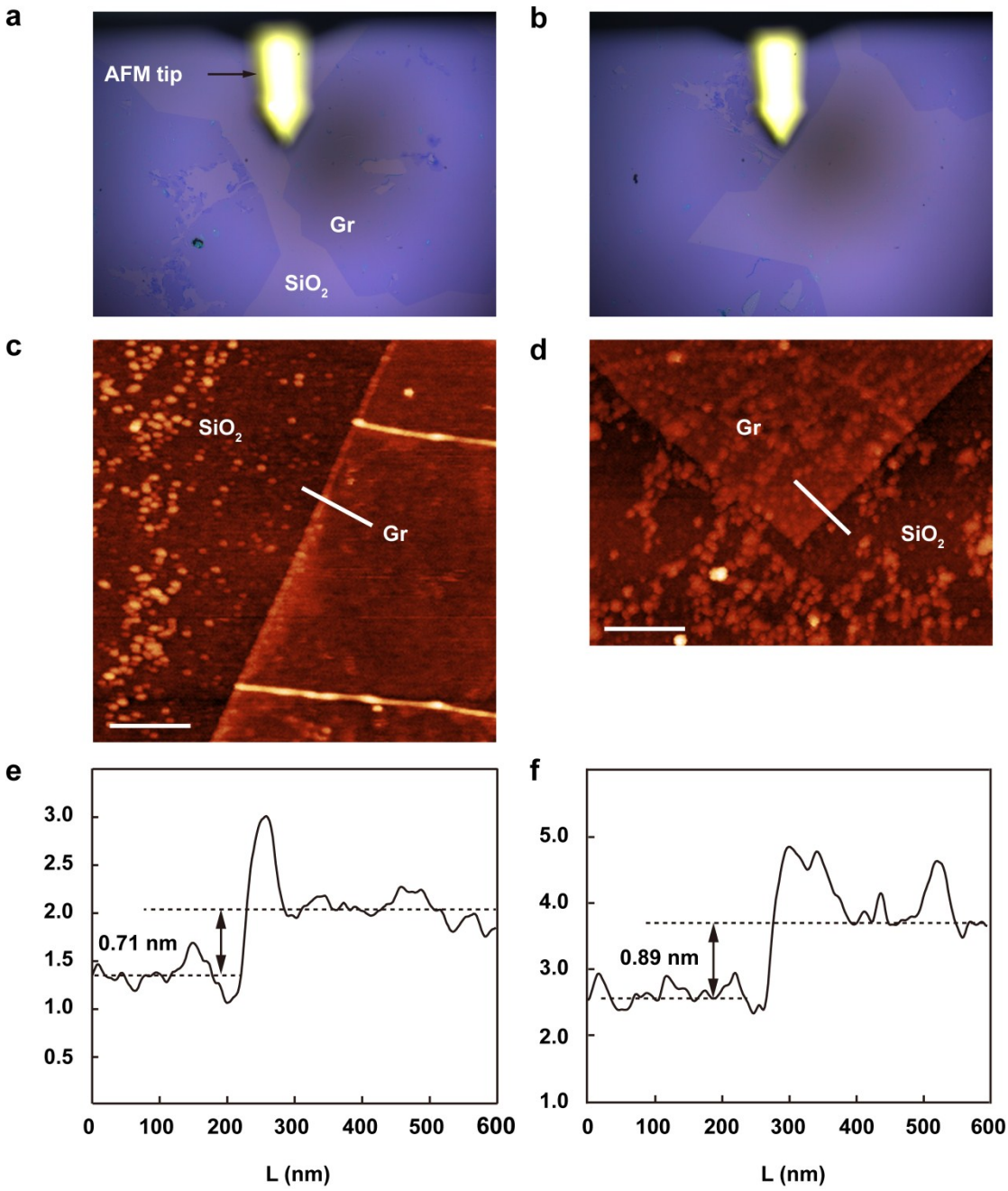

Fig. S1 Optical image and AFM topography of the HNO_3-doped graphene. (a, b) Optical images of two representative graphene flakes after doped with HNO_3. (c, d) Corresponding topographies of the graphene flakes shown in (a) and (b), respectively. (e, f) Height profiles extracted from topography images shown in (c) and (d), respectively.

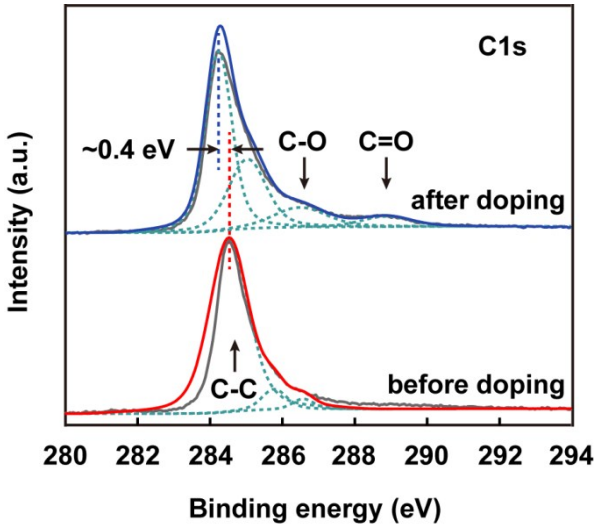

Fig. S2 XPS spectra of the pristine (lower) and HNO_3-doped (upper) graphene. The C1s peak corresponding to sp^2 and sp^3 hybridization states was shifted to low energy (from ~ 284.58 eV to ~ 284.18 eV) by the HNO_3 doping.

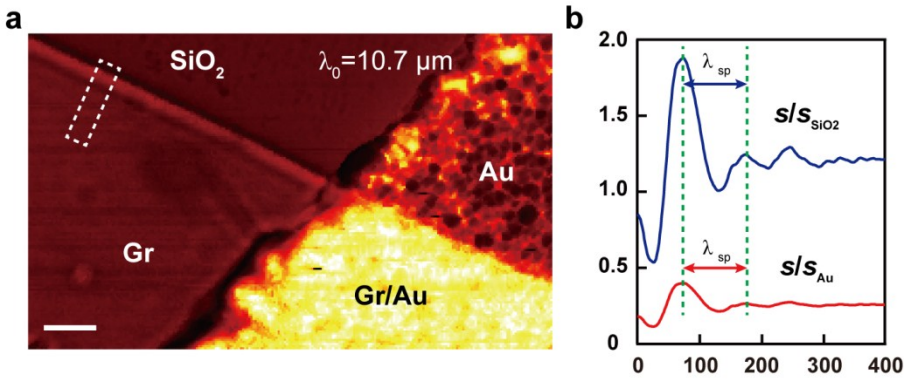

Fig. S3 Plasmon wavelengths deduced from different data normalization methods. (a) Near-field optical image of the monolayer graphene under excitation of 10.70 μm. The monolayer graphene was placed with one part lying on the gold film and the other part on the SiO_2 substrate. Scale bar: 250 nm. (b) Extracted profiles of the near-field optical amplitudes from white-dashed rectangle shown in (a). The profile was normalized to the gold (red) or SiO_2 (blue).

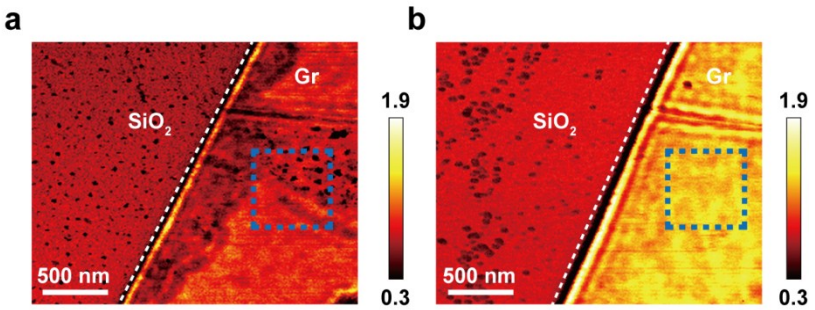

Fig. S4 Optical near-field characteristics of the graphene before and after the HNO_3 doping. (a) Normalized optical near-field imaging of the plasmon waves near edges of the pristine graphene. (b) Normalized optical near-field imaging of the plasmon waves near edges of the chemically-doped graphene. The blue squares depicted the areas where root-mean square of amplitudes of the near-field optical amplitudes were calculated.

Table S1. Binding energy of the H_2O molecule on the graphene obtained from the DFT calculations.

	Binding energy without the NO_3^- group (eV)	Binding energy with the NO_3^- group (eV)
H_2O molecule	0.026	–0.001