Supplemental materials:

Identification of Structural Defects in Graphitic materials by Gas-phase Anisotropic Etching

Shuang Wu, Rong Yang, Dongxia Shi, and Guangyu Zhang*

Nanoscale Physics and Devices Lab, Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China

*Corresponding author (Email): gyzhang@aphy.iphy.ac.cn.

1. Surface morphology of graphite samples.

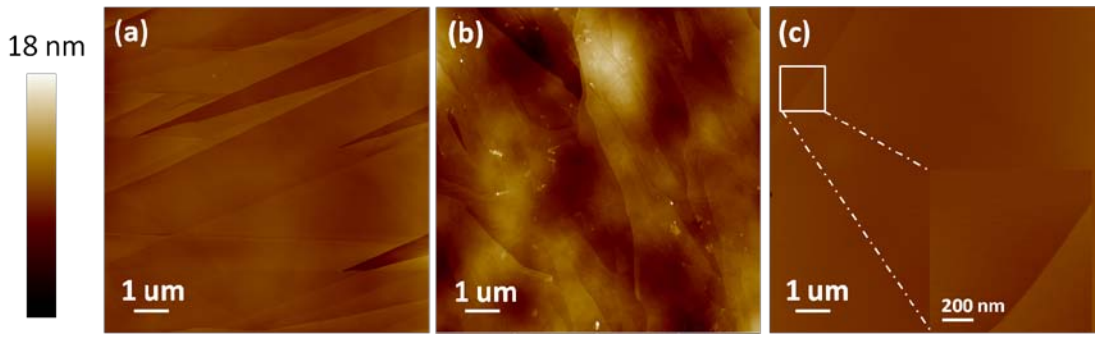

Fig. S1 AFM images of three pristine graphite samples. (a) HOPG-A, (b) HOPG-B, (c) Kish graphite.

2. More Raman data on O- and Ar- plasma treated samples.

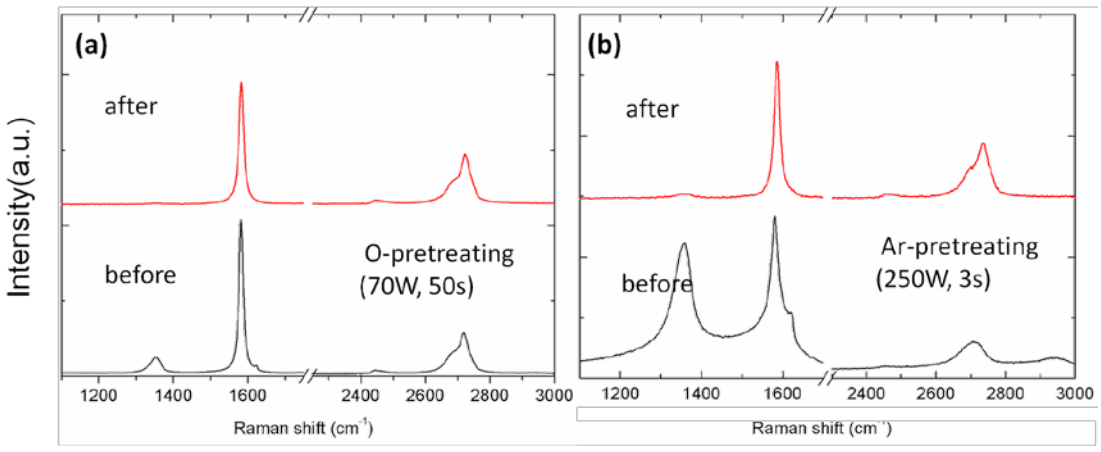

Fig. S2 Raman spectra of graphite with O- and Ar-pretreatment respectively before and after H-plasma etching.

3. Further discussions on Figure 5

The magnification of the three dimensional structure of the multilayer hexagonal pits emerging from non-basal dislocations parallel or inclined at some angle to the c-axis is shown in Fig. 5 (c). The stairs-like steps are contained in the pits as well as the walls taper towards the center-bottom. Two different sized pits with one flat and one point bottom are embedded at the flat bottom of a larger multilayer hexagonal area, which is similar in shape with the computation model of shallow hexagonal pits formation on the graphite surface.[1] With the aid of explanation previously reported,[2] flat-bottomed pits shows that their non-basal dislocation ends at voids and grain boundaries lying in or close to the basal plane. Another one non-basal dislocation can be identified from the bottom right inset image of Fig. 5 (c): A multilayer hexagonal pit with a flat bottom is observed, but its inner asymmetric shape contrasting with the common symmetric hexagonal ones suggests that dislocation sites at the inner-bottomed layers shift along the a-axis on the prolong etching. The inference can be made that non-basal dislocation bends at an angle deviating from the c-axis direction within the graphitic crystal and then assume a random direction lying close to the basal plane, combined with the study on similar layer structures.[3-4] Despite the fact that screw dislocation commonly exists in pyrolytic graphite whose density varies from 0.01 to 5 um^{-2},[5] these depression pits aren't either like ones with screw patterns in pyro-graphite,[5] or hexagonal cone-shaped vortex microholes with the spiral cleavage steps produced by electron beam irradiation emerging from a screw dislocation in HOPG[6] or a left handed growth spiral proving the existence of screw dislocation in oxidized Ticonderoga graphite crystal[7] but resemble the pits constituting intersecting arrays forming L-shaped boundary of edge dislocation,[2] so it is reasonable to infer that the multilayer etched pits in the image are more likely the termini of non-basal edge dislocation than that of non-basal screw dislocation.

References

1. D. Tandon, E. J. Hippo, H. Marsh and E. Sebok, *Carbon*, 1997, **35**, 35-44.
2. C. R. a. J. M. Thomas, *Proceedings of the Royal Society of London. Series A, Mathematical and Physical Sciences*, 1967, **297**, 397-405.
3. R. H. Williams, *Journal of Materials Science*, 1970, **5**, 566-572.
4. A. Sagar and J. J. W. Faust, *Journal of Applied Physics*, 1967, **38**, 482-490.
5. G. R. Hennig, *Science*, 1965, **147**, 733-734.
6. H. Hiura, *Journal of Materials Research*, 2001, **16**, 1287-1292.
7. E. E. G. H. a. J. M. THOMAS, *Nature*, 1962, **193**, 838-840.