Supplementary Information

Electric field-controlled rippling of graphene

Zoltán Osváth[*,§,†], *François Lefloch*[§], *Vincent Bouchiat*[‡], *and Claude Chapelier*[*,§]

[§]SPSMS, UMR-E 9001, CEA-INAC/UJF-Grenoble 1, 17 rue des martyrs, 38054 Grenoble cedex 9, France

[†]Institute for Technical Physics and Materials Science, MFA, Research Centre for Natural Sciences, Hungarian Academy of Sciences, P.O. Box 49, 1525 Budapest, Hungary

[‡]Institut Néel, CNRS and Université Joseph Fourier, BP 166, 38042 Grenoble cedex 9, France

* osvath.zoltan@ttk.mta.hu, claude.chapelier@cea.fr

For the STM measurements we used sharp Nanotips from Bruker. We have imaged the metal/graphene boundary with slow scan speed (0.5 μm/s) and relatively high bias voltage (0.8 V) in order to avoid damaging of the tip. Such an image of the boundary is displayed in Figure 1S. In Fig. 1Sa the color scale is adjusted to emphasize the metal surface topography whereas in Fig. 1Sb it is adjusted for a maximum contrast on the graphene layer. Note that the metallic grains can be easily distinguished from the graphene ripples as shown by the two characteristic height profiles (*1 – 1'*) acquired on the metal and on the graphene, respectively. We observed neither resist residues nor metallic clusters down to the atomic scale on the graphene side.

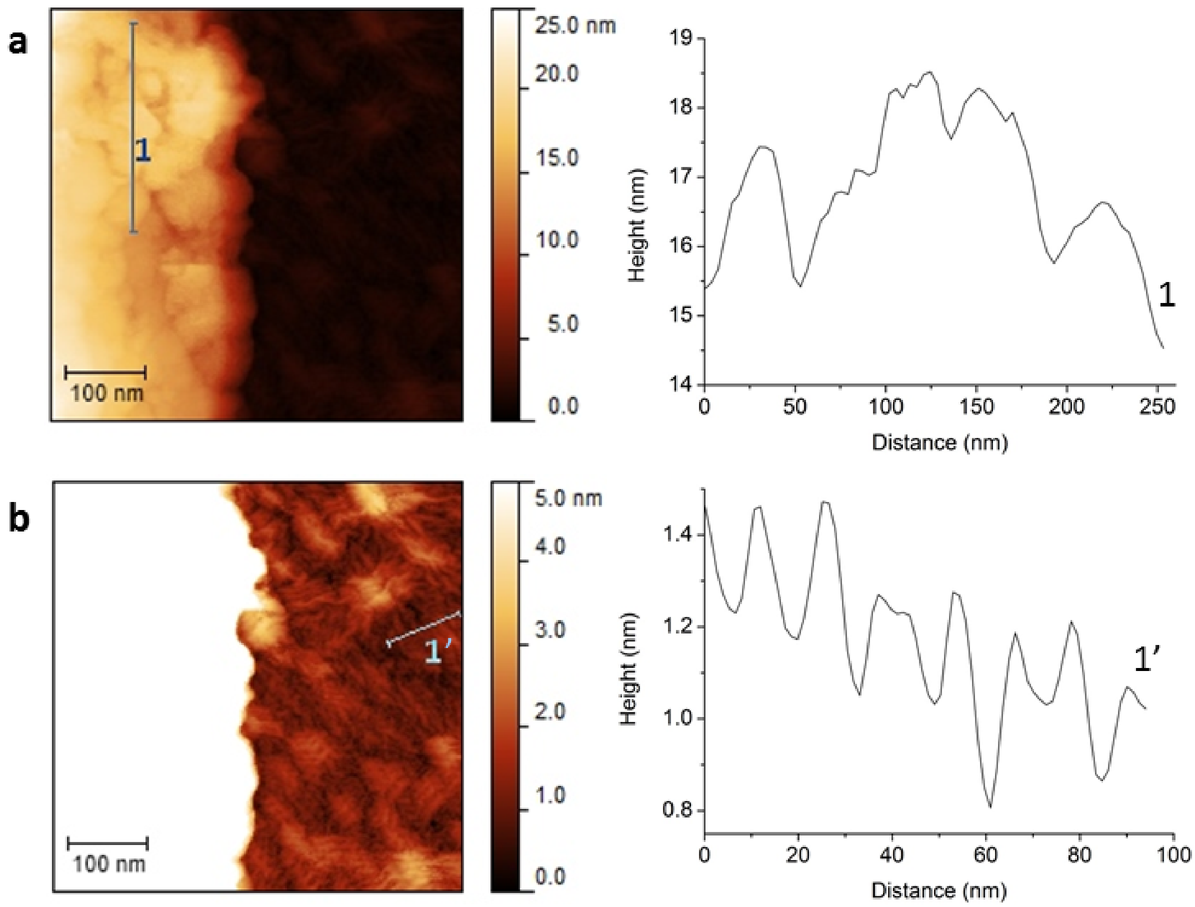

Figure 1S. STM image of the metal/graphene boundary. Tunneling parameters: U = 0.8 V, I = 500 pA. The profile 1 in (a) shows the large and smooth metallic grains of the contact, while the profile 1' in (b) shows graphene short wavelength ripples of about 0.2 nm in amplitude.

As it can be observed in Fig. 1Sb, the contribution from rippling is superimposed to a larger wavelength pattern. To better illustrate this, we show in Figure 2Sa-b the Fourier-decomposed, low-bias STM images of Fig. 2a and 2b of the manuscript, respectively. The left panels display the large wavelength contribution from the substrate (low-pass filtered images), and the right panels show the contribution from rippling (the difference between the original and the low-pass filtered images). Whereas the two left panels emphasizing the large scale corrugation induced by the SiO_2 substrate look quite similar, the rippling contribution is much more pronounced close to the metal/graphene interface (Fig. 2Sb, right panel) than far from it (Fig. 2Sa, right panel). Additionally, the highly strained graphene regions (marked with black dots as in the manuscript) also contribute to the large wavelength pattern. These high topographic features are not observed far from the metal/graphene boundary (Fig. 2Sa).

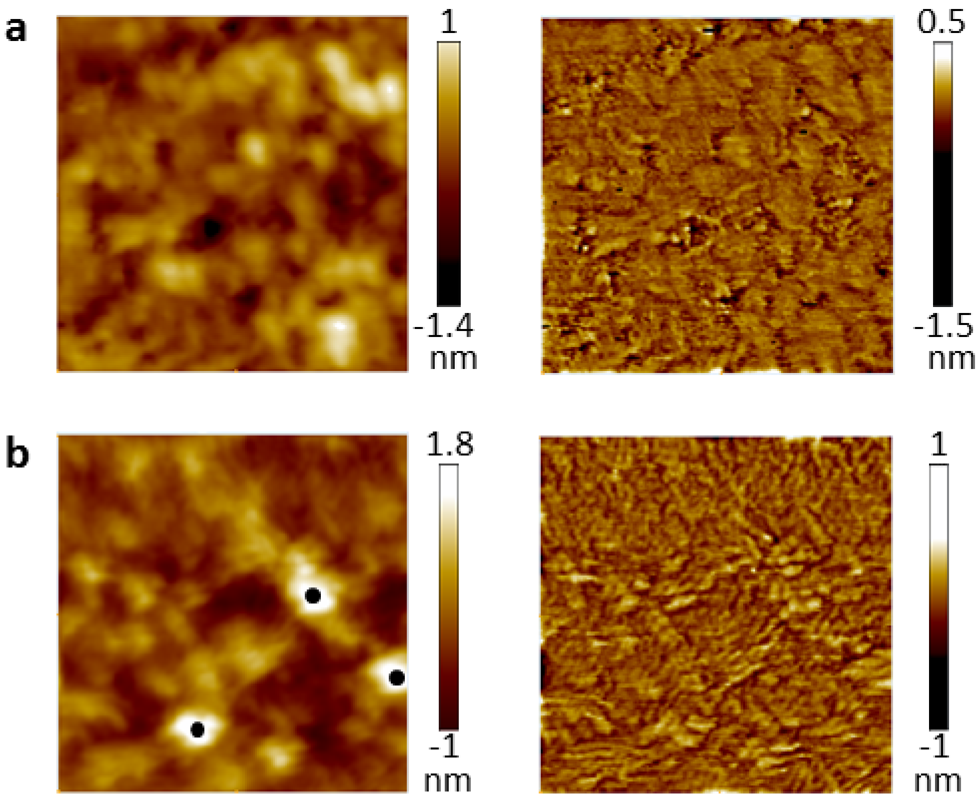

Figure 2S. Fourier-filtered (1st order Butterworth) STM images of (a) Fig. 2a and (b) Fig. 2b of the manuscript, acquired at low bias. Left panels: large wavelength contribution induced by the substrate. Right panels: short wavelength contribution induced by rippling. The black dots denote highly strained graphene regions (discussed in the main text).