Process of strain relief in large area graphene

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Abstract In graphene biaxial compressive strain accumulates during the chemical vapor deposition (CVD) due to a mismatch of the thermal expansion coefficient of copper substrates and graphene.[1-3] Here, we show experimentally that this strain is released in three successive steps. (i) Initially during cool-down from the growth temperature graphene causes a corrugation of the Cu surface (see Fig.1). We demonstrate that the restructuring of the Cu surface is driven by strain due to the presence of graphene. Moreover, this leads to an increase of the graphene area by about 1%. (ii) in-situ Raman measurements reveal that the removal of the Cu substrate causes a significant strain relaxation, and (iii) additional strain is relieved when graphene is transferred to SiO_2 substrates. We quantify the amount of strain which relaxes during each step and deduce the residual strain remaining in transferred graphene.

References

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Figures

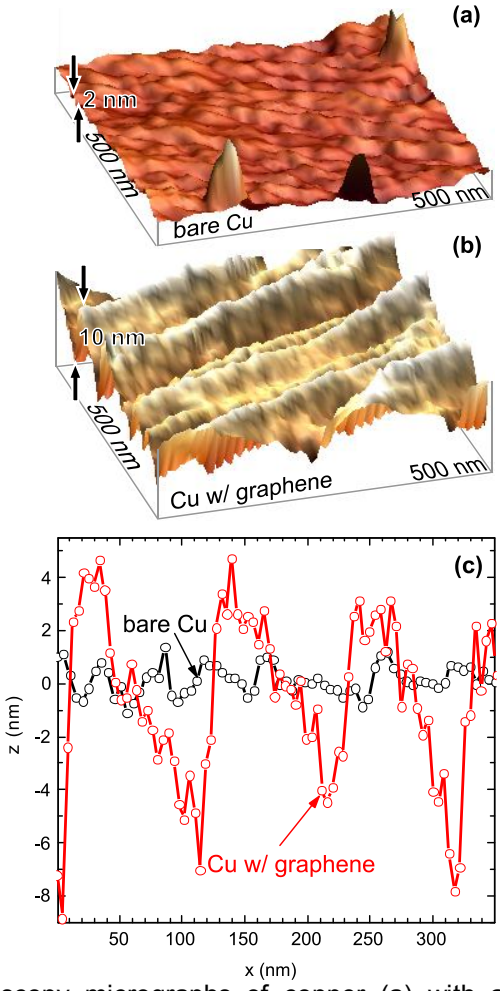

Figure 1. Atomic force microscopy micrographs of copper (a) with and (b) without the growth of graphene. Note that sample (a) underwent the same process as (b) just without CH_4 flow. (c) shows line scans of the corresponding surfaces depicted in (a) and (b).