Observation of visible-frequency graphene plasmons in nanocorrugated graphene

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Abstract

Graphene plasmons possess many intriguing properties, outperforming conventional plasmonic materials in terms of mode volume confinement, environmental stability and biocompatibility. Graphene plasmons have been directly imaged by scattering type Scanning Near-field Optical Microscopy (SNOM) measurements at IR frequencies, through detecting their interference patterns near edges and defects [1,2]. Here we show that heavily nanocorrugated graphene sheets can also support graphene plasmons of visible frequency. We were able to image their interference patterns by SNOM measurements at visible (λ = 488 nm) frequencies (Figure 1). Visible graphene plasmons also manifest themselves through mediating several orders of magnitude stronger Raman enhancement than previously achieved with graphene, enabling the optical detection of specific molecules from femtomolar solutions or even ambient air [3].

References

[1] Chen, J., *et al*. Optical nano-imaging of gate-tunable graphene plasmons. *Nature* 487, 77 (2012).
[2] Fei, Z., *et al*. Gate-tuning of graphene plasmons revealed by infrared nano-imaging. *Nature* 487, 82 (2012)
[3] Dobrik, G., ,…& Tapaszto, L. Large-area nanoengineering of graphene corrugations for visible-frequency graphene plasmons. Nature *Nanotechnology* 17, 61 (2022)

Figures

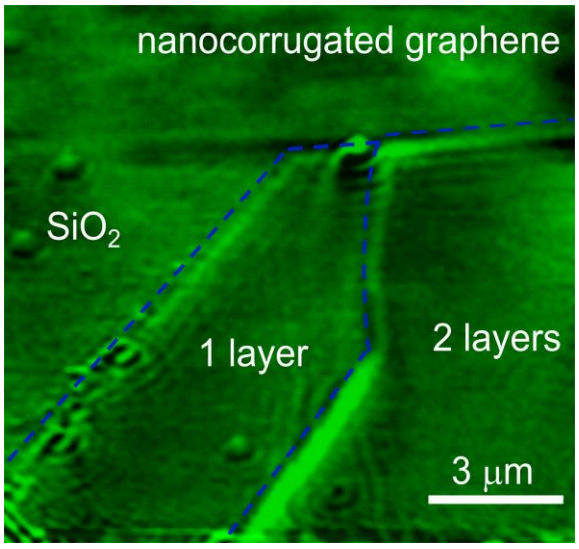

Figure 1: *SNOM image (λ = 488nm) of nanocorrugated graphene revealing clear interference maxima and oscillations in the proximity of edges (marked by blue dashed lines).*