Polymeric micro-actuators for periodically strained graphene

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Polymeric thin films have been recently exploited to create highly customized micro-actuators to induce non-trivial strain profiles in graphene [1, 2], paving the way to a novel strategy for the development of periodic strain configurations [3]. I will report a detailed study on the mechanical response of poly-methyl-methacrylate (PMMA) layers under strong electron irradiation in a scanning electron microscope [4]. Two complementary methods are used to study the effects of electron irradiation. In a first set of experiments PMMA is deposited on SiN-cantilevers and the polymer contraction is quantified by looking at the change of the cantilever deflection using an optical profilometer. In a second step, PMMA is patterned onto a bilayer of epitaxial graphene [figure 1a] and the PMMA shrinkage is measured based on sets of SEM images taken at different electron doses and energies. Finally, I will discuss how polymeric actuators can be used to confine electrons through the creation of pseudo-magnetic field superlattices, induced by periodic strain profiles [figure 1b].

References

[1] H. Shioya *et al.* Nano Lett. 14, 3 (2014) 1158-1163.
[2] F. Colangelo *et al.* 2D Mater. 5, 4 (2018) 045032.
[3] D. Giambastiani *et al.* arXiv 2107 (2021) 07783.
[4] D. Giambastiani *et al.* J. Appl. Phys. 128 (2020) 115104.

Figures

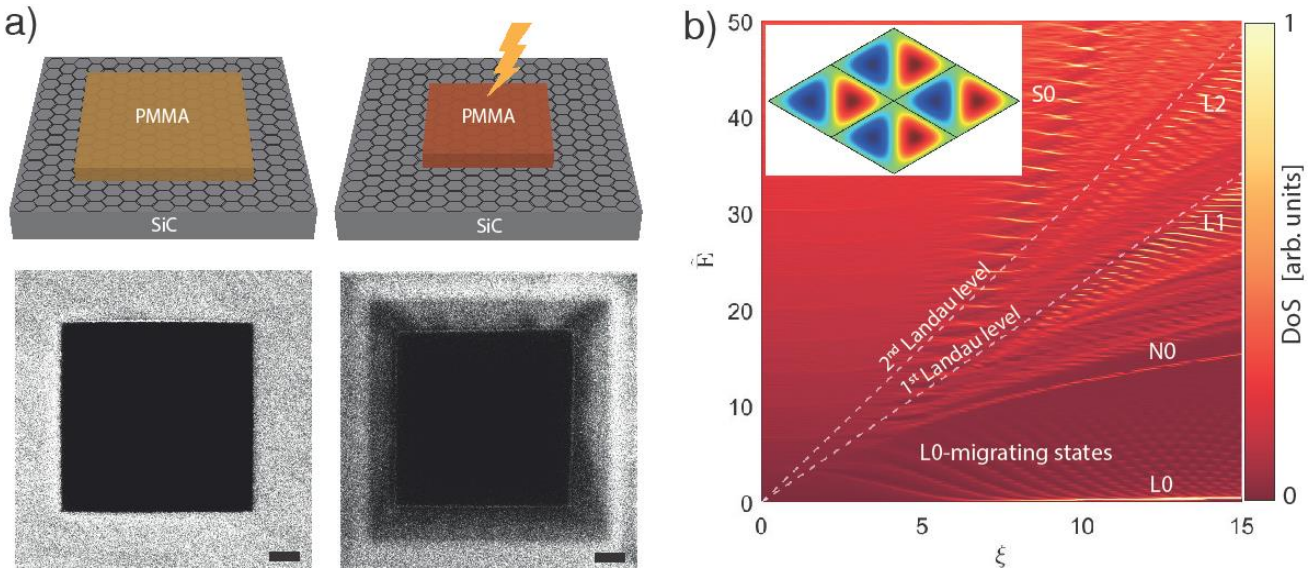

Figure 1: a) Top: schematic diagram of the experiment involving PMMA patterned onto a bilayer of epitaxial graphene. From left to right, the panels illustrate the e-beam induced shrinkage of PMMA. Bottom: SEM image of the experiment showing the PMMA block before (left) and after (right) e-beam irradiation. The scale bar is 600 nm. b) Density of states (main panel) obtained from the solution of the Dirac equation, in presence of the periodic pseudo-magnetic field shown in the inset panel.