Angle-resolved energy loss spectroscopy experiments on graphene/metal interfaces and on topological insulators: a powerful tool for investigating vibrational, elastic and electronic properties

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Abstract

Angle-resolved electron energy loss spectroscopy has been used to study phonon and plasmon dispersion in monolayer graphene (MLG) on Pt(111) and in periodically rippled graphene on Ru(0001). We found that the dispersion relation of the low-energy plasmon mode (0-3 eV) confined in the graphene sheet is acousticlike. The linear dispersion relation of its frequency is caused by the non-local screening of the electrons in MLG due to the presence of the underlying metal substrate [1, 2]. Moreover, a quadratic dispersion of the π plasmon of graphene/Pt(111) (6-8 eV) has been observed, in contrast to the linear dispersion reported for monolayer graphene grown on the semiconductor SiC(0001) substrate. The π plasmon is instead confined within graphene nanodomes on Ru(0001).

The elastic properties of a macroscopic graphene sample grown on Pt(111) and Ru(0001), extrapolated from experiments on phonon dispersion, showed values similar to the theoretical strength for free-standing graphene. Our results indicate that the excellent crystalline quality of graphene grown on metal substrates leads to macroscopic samples of high tensile strength [3]. We also report on the differences in the phonon spectrum between graphene grown on Pt(111) and on Ru(0001) [4].

In the second part of the talk, I will introduce low-energy collective electronic excitations in (0001)-oriented Bi_2Se_3 topological insulator.

References

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