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Bandgap opening in Graphene on Ir (111) mediated by Tellurium intercalation

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Graphene (Gr), in its pristine state, is a semiconductor with a zero band gap and massless Dirac fermions carriers, which conduct electrons like a metal. Nevertheless, the absence of bandgap makes it impossible to control the material's electrons, something essential, for example, to perform on-off switching operations in transistors. Therefore, it is necessary to generate a finite gap in the energy dispersion at the Dirac point (DP). An intense research has been developed to engineer band gaps while preserving the exceptional properties of Gr and different strategies have been proposed, among them, quantum confinement of 1D nanoribbons [1] or the introduction of a superperiodic potential in graphene [2]. Besides, in the context of developing new 2D materials and Van der Waals heterostructures, with new exciting emerging properties, as 2D transition metal chalcogenides monolayers, it is fundamental to know any possible interaction between chacogenide atoms and Gr supporting substrates. In this work, we report on a combined Scanning Tunneling Microscopy (STM), Low Energy Electron Diffraction (LEED) and Angle Resolved Photoemission Spectroscopy (ARPES) study entirely conducted at IMDEA Nanociencia on a new superstructure when Te is intercalated on Gr over Ir(111). Additionally, High Resolution-ARPES measurements were performed at VUV beamline in Elettra Synchrotron. This new superstructure leads to the electronic doping of the Dirac cone (up to ~ 370 meV), while the linear dispersion of massless Dirac fermions is preserved, being the doping level directly related to the ammount of evaporated Te. Very interestingly, our ARPES measurements evidence a large band gap (~ 410 meV) at the DP of graphene Dirac cones, below but close to the Fermi level.

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