Changes in the properties of graphene produced by metal contacts investigated by Raman spectroscopy and transport experiments

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Abstract

It's important to study how graphene behaves when different metals are deposited over it to control exactly the operation of future graphene-based nanodevices, which could be affected by this interaction. A priori, we would expect some doping caused by the difference in work function between the metal and graphene, which would alter the electron-phonon interaction. Raman spectroscopy -- a non-invasive method that completely characterises graphene through different peaks corresponding to vibrational modes and that are used to determine the quality of the sample — is the most effective way to detect this change in the electron-phonon interaction [1].

In this work, we show Raman spectra for different samples: first, we exfoliated graphene over 285nm of SiO_2 substrates; second, we evaporated 3nm of metals by electron beam evaporation over graphene flakes. The changes on Raman spectra obtained for both G and 2D peaks don't correspond to what we would expect due to differences in work function but must be explained by other phenomena, for example, stress.

For Co, two new peaks appear at the Raman spectrum (see figure 1). A study over time was carried out to check whether the new peaks were a consequence of stress or had another origin. We soon rejected the first option and opted for a strong bonding between graphene and cobalt that could introduce new vibrational modes; in fact, some theoretical studies [2], [3], [4] show that Co (0001) and Ni (111) are chemisorbed over graphene –with a much smaller binding distance--, whereas most other metals are just physisorbed. Finally, to study the electronic properties of Co over graphene grown by CVD, we produced some devices by electron beam lithography (figure 2). The first results indicate clear changes in the Dirac-point curve, obtained by means of an applied back voltage.

References

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Figures

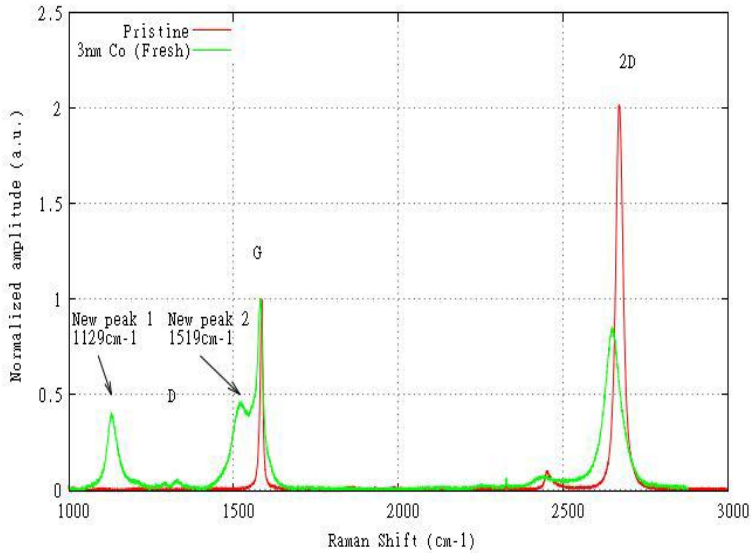

Figure. 1: Raman spectrum of a cobalt-graphene sample (normalized to the G peak intensity after background removal).

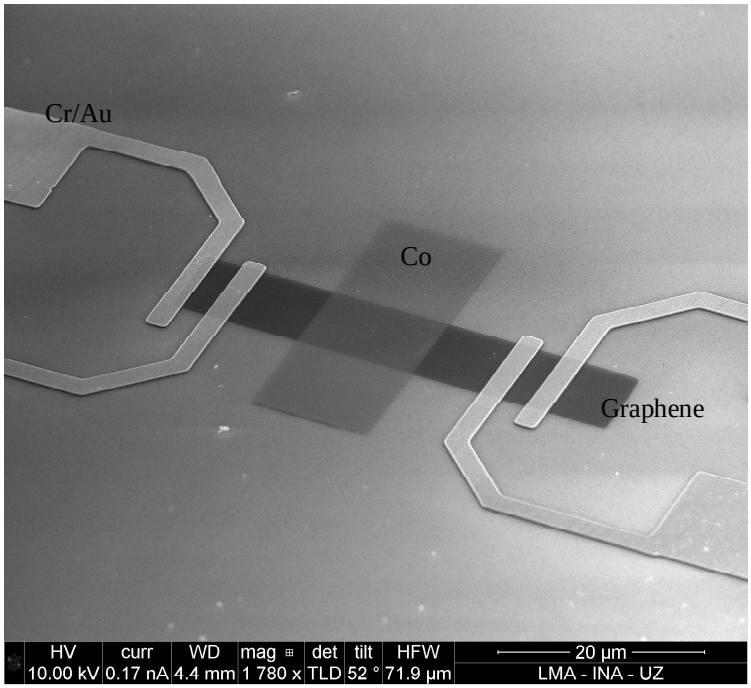

Figure 2: Graphene based device with 3nm Co layer.