

Surface Potential and Photoresponsive Behavior at Graphene-Metal Interfaces

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Graphene has remarkable photonic properties and, combined with its exceptional electronic transport properties, has led to a number of unique photonic devices.¹⁻³ Among these are photodetectors utilizing the photo thermoelectric effect, where devices are fabricated having metal contacts with differing work functions.^{2,3} Yet, since metals contact-dope graphene, the (unintentional) formation of junctions at the edge of each contact may increase contact resistance as well as generate a photoresponse when illuminated. Despite the ubiquitous presence of metal junctions in all device types, little work exists that describes the behavior of non-noble metals on graphene. Hence, we present a preliminary study of the interactions between graphene and wide range of metals.

Here, we measure the work function, Φ , of a wide variety of metals deposited on monolayer epitaxial graphene synthesized on SiC. We find a discrepancy between the measured and reported Φ of metals traditionally considered to have low values, with the Φ measured on graphene being consistently higher. We also characterize the films with photovoltage and Raman spectroscopy. For example, Yb films exhibit the strongest photovoltage response despite having a modest Φ , and we identify several metals having significant adhesion issues to graphene. In addition, Eu films on graphene have unique phonon signatures with strong Raman peaks at high energies ($>1900\text{cm}^{-1}$) in the spectrum. These peaks may be due to Eu-adsorption within the graphene lattice.⁴ A closer look at the graphene-metal interface of Er films via Raman Spectroscopy (Fig. 1) shows evidence of disorder in the graphene lattice at the metal-graphene-air contact point, suggesting bonding with the graphene lattice may occur during oxidation. Such interactions are candidates to influence electronic transport across graphene-metal contacts.

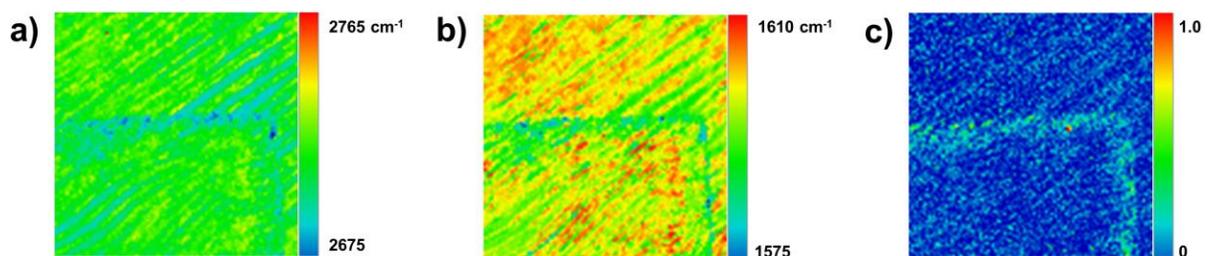


Figure 1: Raman spectroscopic map of graphene-Er films after Er removal, showing the graphene a) 2D peak position, b) G peak position and c) D/G peak ratio.

References:

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Supplementary Page

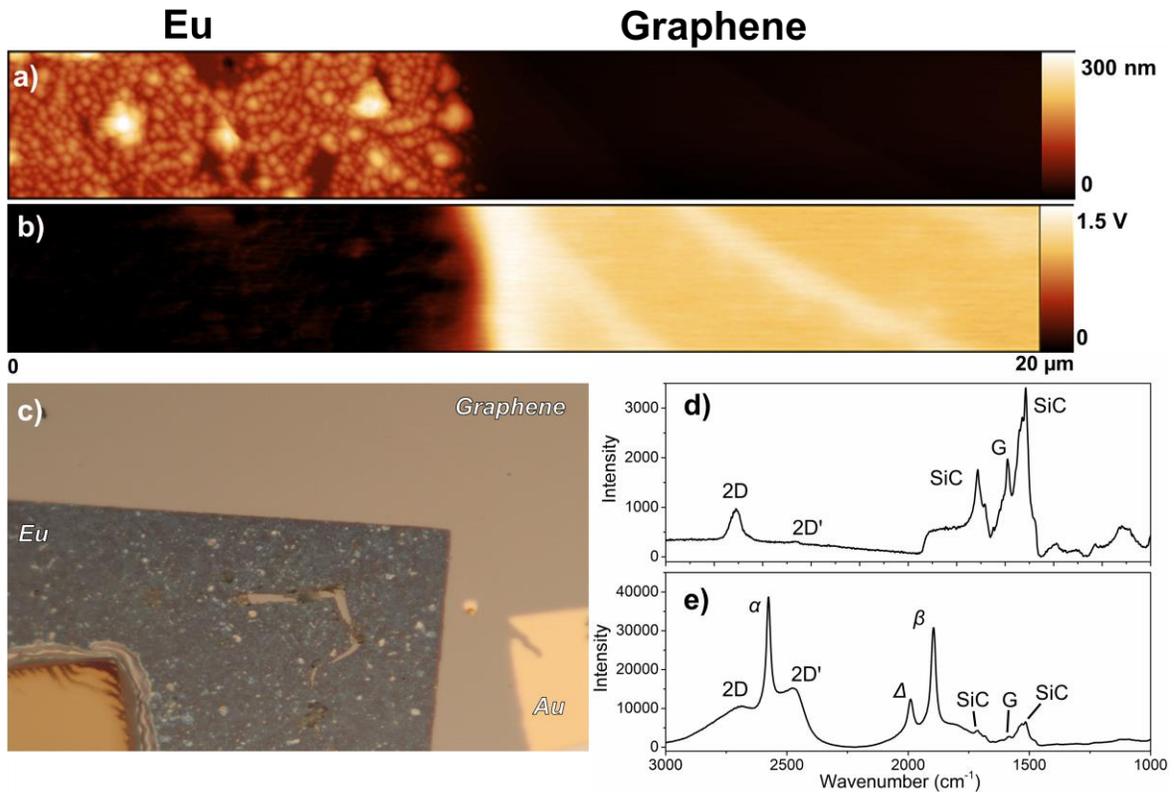


Figure 2: a) AFM height profile and b) KPFM surface potential scans of Eu films on graphene. Despite a rough surface film, the surface potential is continuous. c) An optical image of the Eu and graphene interface. The Eu film is immediately noticeable from its blue appearance. Blue is not an expected color of Eu, and may be from a thickness induced interference effect. Raman Spectra of the d) bare graphene and e) Eu film on graphene show unique signatures. In both scans, the SiC and graphene 2D/G peaks are present. For the Eu scan, three additional peaks are found at 1893cm^{-1} , 1990cm^{-1} , and 2575cm^{-1} , labelled β , Δ , and α , respectively. These peaks are significantly stronger in intensity, and may be the result of Eu adsorption or intercalation into the graphene lattice.