

Functionalization of Graphene with Magnetic Nanoparticles

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While graphene is nonmagnetic in itself, experimental observations show that its magnetism can be induced by introduction of impurities, boundaries or defects¹. The properties of graphene can also be modified by doping, chemical functionalization or decoration by nanoparticles (NPs)². In addition, magnetic NPs have interesting properties, dependent on their size.

In this work, we are interested in chemical non covalent functionalization of graphene by magnetic NPs. The electronic and transport properties of modified graphene will be evaluated thanks to local measurements using AFM-derived techniques³. This type of functionalization is a very attractive method because it offers the possibility of attaching functional groups on graphene without disturbing its crystalline network⁴. Figure 1 shows our synthetic methodology. A phosphine ligand bearing a pyrene entity and the nanoparticle precursor is synthesized. It is then deposited onto graphene (CVD or scotch-taped) by dip coating. A subsequent thermal treatment allows removal of organic parts, leaving only the metallic core on the carbon surface.

We have synthesized three different compounds with the following metal (M)-ligand (L) ratios: $\text{Co}_4(\text{CO})_{11}\text{L}$, $\text{Fe}(\text{CO})_3\text{L}_2$ and

NiL_2 . Samples of CVD single-sheet graphene supported on TEM grids were functionalized by grids immersion into the M-L solution to allow the molecule to interact by π - π stacking. Each grid then underwent a thermal treatment under inert atmosphere. Finally, TEM images are obtained in order to evaluate the dispersion of nanoparticles and determine their size. Scotch-taped graphene transferred to silicon substrate can also be modified with NPs and connected with Ti/Au electrodes for local probe measurements. The electronic and transport properties of graphene and the influence of magnetic NPs are studied, to gain fundamental insight into the mechanisms at play.

References

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Figures

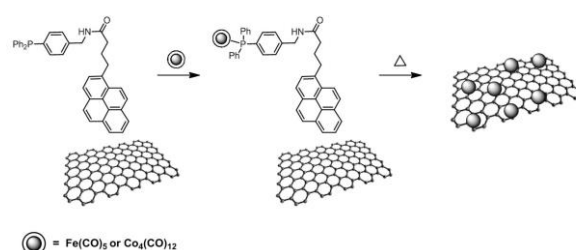


Figure 1: Non covalent functionalization of graphene by magnetic NPs
