Metal growth on graphene:morphology, intercalation and magnetization

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Graphene based electronic and spintronic devices require understanding of the growth of metals on graphene. Several metals (Gd, Dy, Eu, Fe,Pb) were studied with STM and DFT. The grown morphology (island density and domain size distributions) was used to extract the metal diffusion and adsorption barriers. For practically all metals the grown mode is 3-d as a result of the low ratio of the metal adsorption energy on graphene to the metal cohesive energy[1]. It is essential to find ways to modify the growth to layer–by–layer for high quality metal contacts in graphene devices and for using graphene as spin filter. These experimental results are fully supported with DFT calculations.

The growth of Fe on graphene is unusual because the nucleated island increases continuously with deposited amount which indicates the presence of long range repulsive interactions. [2]. An advantage is the tunability of the island density which can be useful for magnetic storage applications. Dy was found to grow fcc(111) instead of hcp(0001) islands expected from its bulk structure. This is seen from the triangular island shape and the ABCABC (instead of ABABAB) stacking sequence of islands nucleating on successive layers[3].

Ex situ SMOKE nagnetization measurements on the Fe islands show a transition from superparamagnetic to ferromagnetic islands with coverage. XMCD measurements on the Dy islands show that the islands are paramagnetic .

Initial experiments on graphene partially intercalated with Dy show that nucleation is preferred on the intercalated areas, which can be used for patterning metal films grown on graphene.
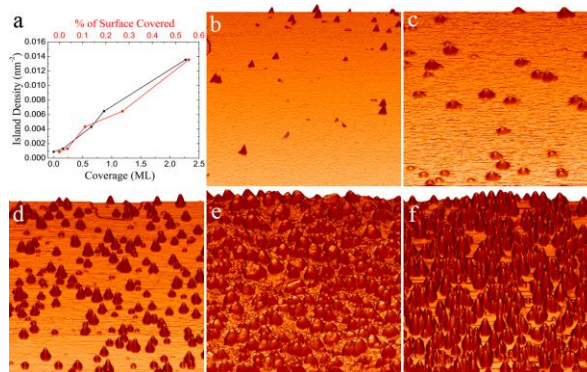

Figure 1: 200x200nm^2 Fe nucleation on graphene shows increasing Island density with Fe deposited amount

References

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