Science at the Edge
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Epitaxial growth and control of metal nanostructures on graphene

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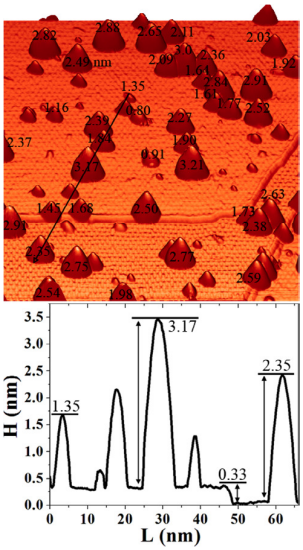
ABSTRACT

Graphene based electronic and spintronic devices require understanding the growth of metals on graphene. Several metals (Gd, Dy, Eu, Fe,Pb) were studied with STM. 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 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 which is necessary 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 figure shows ~20 layer Fe islands after only 0.6ML Fe deposition).

The growth of Fe on graphene is unusual because it does not follow classical nucleation. The nucleated island density is unexpectedly high, it increases continuously with deposited amount θ and shows no temperature dependence.[2] These unexpected results indicate the presence of long range repulsive interactions, which can be used to tune the island density with the Fe deposited amount. This can be useful for magnetic storage applications.

Dy was found to grow fcc(111) islands instead of the expected hcp(0001) islands 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]. It is interesting to compare the magnetic properties of fcc(111) vs hcp(0001) Dy nanoislands.

References

1. M. Hupalo, X. Liu, C. Wang, W-C Lu, Y. X. Yao, K. Ho, and M. C. Tringides *Adv. Mat.* 23 2082 (2011)
2.S. Binz, M.Hupalo, Xiaojie Liu, C. Z. Wang, Wen-Cai Lu, P. A. Thiel, K. M. Ho, E.H.Conrad and M. C. Tringides *Phys. Rev. Let.* 109, 026103 (2012)
3. M T Hershberger, M Hupalo, P. A. Thiel and M C Tringides *J. Phys.: Condens. Matter* 25 225005

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