Atomic Resolution Imaging of Individual Metallofullerenes on Graphene and within Graphene Sandwiches

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Abstract:
The ability to expand the application of graphene in 2D devices requires the integration of other non-2D systems to obtain unique doping, band structure modification and new vertical stacked heterostructure geometries. This can be achieved by using monolayers of molecules, such as endohedral metallofullerenes (MFs),[1,2] self-assembled onto the surface of graphene and within vertically stacked graphene sandwiches. The atomic level interactions between MFs, such as $Gd_3N@C_{80}$,[3] with suspended graphene monolayers has yet to be revealed in detail. In particular the formation of graphene sandwiches filled with MFs will open up new vertical heterostructures for devices.

I will present results on the imaging individual MFs on graphene and within graphene sandwiches using low-voltage (60kV) aberration-corrected annular dark field scanning transmission electron microscopy (ADF-STEM). Pristine graphene acts as both a substrate to immobilize the MFs, and in sandwich form as a protective layer to enable the study of individual MF structure and dynamics. I will discuss individual MF interactions with the graphene surfaces, such as binding locations, diffusion, aggregation and rotational dynamics, as well as inter-fullerene interactions such as fusion. Direct imaging of the metal trimer cage is obtained, figure 1, at temperatures up to 700°C, revealing insights into the thermal stability. The results shed light on how to gain control over the arrangement and spatial distribution of MFs interfaced with graphene for electronic and opto-electronic devices.

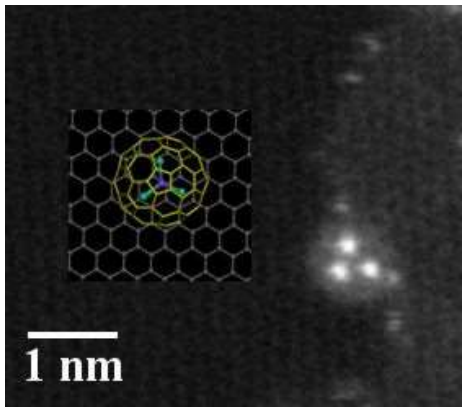

Figure 1: *Endohedral fullerene ($Gd_3N@C_{80}$) on graphene.*

References:

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