

## Radicals and Intercalated Graphene

**Even the worlds most interesting material has its limits. It is possible to add material beneath graphene, and it is possible to add material on top of graphene, but not always at the same time. This doesn't have to be a bad thing though. If you wanted to control the flow of objects beneath graphene, for example, you could guide it from the top. In this project, how material above and below graphene interacts will be studied.**

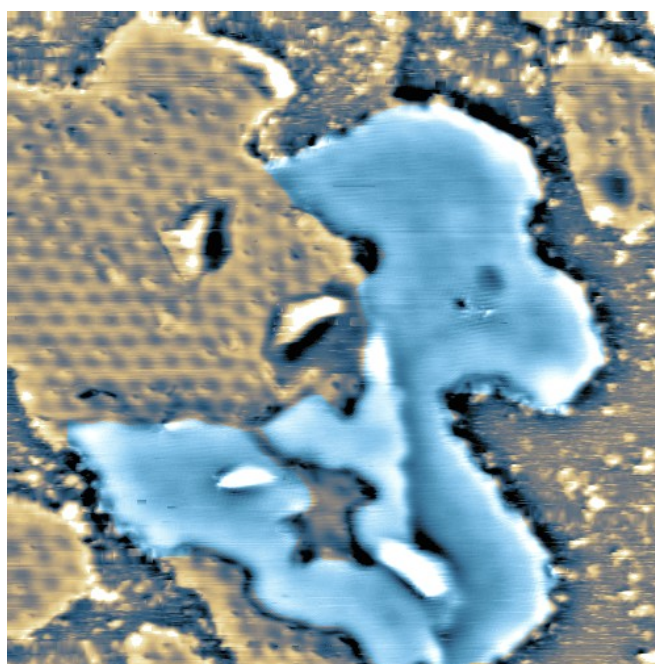
Graphene has gotten a lot of attention in the media lately for being a material with fantastic properties. While being one of the worlds thinnest materials, at just one atomic layer thick, graphene also has qualities that make it useful in industry applications, such as conducting electricity and heat easily, and being stronger than steel. With these useful features, much attention has been paid to it in the field of research, in order to further refine its abilities. When flakes of graphene are present, two possible modifications are to add material beneath the flakes, or to add material on top of the flakes. How charged particles called radicals attach to graphene which has been intercalated (graphene flakes which have had material added beneath it) is the purpose of this project.

In order to conduct an experiment on graphene flakes, flakes of graphene first needed to be created. Creating of graphene occurred in an ultra- high vacuum (UHV) chamber, which allowed for an isolated study of graphene and the radicals being dosed. A vacuum classifies as ultra-high when it achieves a pressure that is one million millionths of the atmospheres pressure. In the chamber, graphene flakes are created and then intercalated with carbon monoxide. Afterwards, organic compounds were heated in order to produce radicals.

To the right is a figure of several graphene flakes, with intercalated sections in blue. This image was taken using the scanning tunneling

microscopy (STM) technique. STM is an atomic scale microscope which scans across a sample and provides height information about the surface. The graphene flakes consist of alternating light and dark sections which form into a hexagonal pattern. Normally, the blue, intercalated section will encompass an entire graphene flake, but when radicals are present, channels like the one in the figure can be formed.

Data on the effect radicals have on intercalation could have many potential applications. The most obvious is in guiding the flow of intercalants beneath the graphene by modifying the graphene's surface with radicals. Conversely, if someone wants to ensure that carbon monoxide doesn't enter beneath graphene, they can dose radicals to it before hand. While applications may be limited right now, with further study, much more will be attainable when using graphene.



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