Kaivalyakumar Mevada

Tent for atoms and molecules

Graphene is the thinnest two-dimensional material discovered, with the thickness of 0.34 nm, made up of single layer of carbon atoms arranged in a honeycomb structure in a plane. To get an idea how thin it is, consider a coin of 1.5mm thickness, graphene is 4.5 million times thinner than that. Historically, graphene was extracted by isolating a single layer of graphite with sticky tape, since it is the building block of graphite. One can imagine a book as graphite then a single sheet of paper is graphene.

Today graphene is grown in laboratories on metal substrate by extracting carbon atoms from hydrocarbon gas. It has gained popularity among researcher due to its unique properties; very high electron and heat conductivity. However, little is known on how its properties are modified upon interaction with other atoms and molecules. In this work, we study graphene by introducing atoms and molecules between graphene and its substrate. This process is called intercalation.

Intercalation of graphene is similar to the process of setting up a tent. Your cloth lying on the ground resembles graphene on its substrate. Next step in setting up a tent is to elevate the cloth from the ground with the help of a pole. In my experiments, water is formed beneath graphene by sequential dosing of oxygen and hydrogen and this water acts as a pole and elevates graphene from its substrate.

Now that the tent is ready a person can easily enter in the tent. We use carbon monoxide, CO molecules, to intercalate graphene. We propose a mechanism for how CO intercalation starts. The CO molecules enter beneath graphene from the region where there is water trapped below graphene. Similarly, a person enters the tent from where it is elevated by the pole and not from where the cloth is fixed to the ground.

Instead of water if xenon atoms are used to elevate graphene then CO molecules are not able to intercalate graphene. Thus, CO intercalation of graphene is highly dependent on the atoms or molecules that elevate graphene from its substrate.

Supervisor: **Jan Knudsen, Foteini Ravani**
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Division of Synchrotron Radiation Research, Department of Physics, Lunds University