Graphene, world's thinnest material, made useable

World's thinnest material graphene, as thin as a single atom but consisting of millions of atoms. By attaching molecules from our own immune system to it quick diagnostics might be possible. This attachment has been shown to be possible.

Graphene, long thought to be an impossible material, was first produced in the early 2000s. Graphene has many extreme properties, it is incredibly strong, conducts electricity and heat incredibly good and is of course as thin as it gets. However just as graphene is incredibly strong it is also very hard to modify.

The part of the immune system that have been combined with graphene are molecules called antibodies. Antibodies can be found in our blood and are part of the first line of defense against sickness. They attach to harmful substances in our blood and signal the body to destroy them. By attaching the antibodies to graphene it is possible to detect when if the antibodies have attached to harmful substances and thus it is possible to detect if someone is sick or not. This can be detected by applying a voltage to the graphene and measure the current. If the antibodies have attached to a harmful substance the current will change.

Attaching anything to graphene is not easy. Graphene is a very stable material and is quite satisfied with being the way it is. To be able to attach an antibody first another molecule has been used to break up the graphene. A small molecule called an aryl radical which is very reactive was used. This molecule attached to the graphene and then the antibodies were attached to them. Normally attaching this aryl radical takes many hours but by using a smart trick it only takes a few seconds. If a molecule called a diazonium salt is put together with the graphene a current can be used to produce aryl radicals from the diazonium salt. Then the aryl radicals will have no choice but to attach to the graphene.

The work has shown that attaching antibodies to graphene is possible and that the function of the antibodies is detectable by electrical measurements. The way of attaching the antibodies is such that after the initial attachment of aryl radical the antibodies can be switched to any other biomolecule. Using this initial step graphene can be modified with almost any biomolecule, increasing its usefulness massively.