Nanomaterials: “Superheated” Water that can Corrode Diamonds
Novel discovery paves the way to improve waste degradation and laser-assisted etching of materials

A team of researchers from the National University of Singapore (NUS) led by Professor Loh Kian Ping, Head of the Department of Chemistry at the NUS Faculty of Science, has successfully altered the properties of water, making it corrosive enough to etch diamonds. This was achieved by attaching a layer of graphene on diamond and heated to high temperatures. Water molecules trapped between them become highly corrosive, as opposed to normal water.

This novel discovery, reported for the first time, has wide-ranging industrial applications, from environmentally-friendly degradation of organic wastes to laser-assisted etching of semiconductor or dielectric films.

The findings were published online in *Nature Communications* on 5 March 2013 with Candy Lim Yi Xuan, a student of NUS graduate School, as the first author.

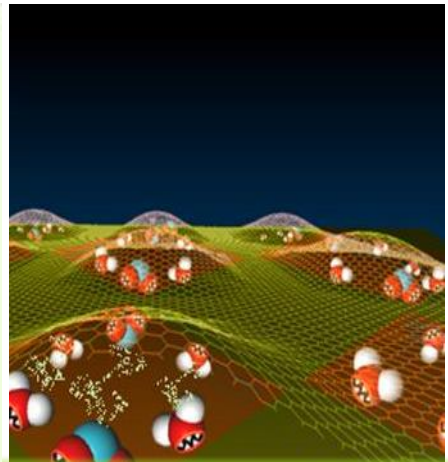

Figure 1: Etching of diamond by “superheated” water
[Image source: Nature Communications]

When Diamond Meets Graphene

While diamond is known to be a material with superlative physical qualities, little is known about how it interfaces with graphene, a one-atom thick substance composed of pure carbon.

A team of scientists from NUS, Bruker Singapore and Hasselt University Wetenschapspark in Belgium, sought to explore what happens when a layer of graphene, behaving like a soft membrane, is attached on diamond, which is also composed of carbon. To encourage bonding between the two rather dissimilar carbon forms, the researchers heated them to high temperatures.

At elevated temperatures, the team noted a restructuring of the interface and chemical bonding between graphene and diamond. As graphene is an impermeable material, water trapped between the diamond and graphene cannot escape. At a temperature that is above 400 degree Celsius, the trapped water transforms into a distinct supercritical phase, with different behaviours compared to normal water.

Industrial Applications and New Insights

Due to its transparent nature, the graphene bubble-on-diamond platform provides a novel way of studying the behaviours of liquids at high pressures and high temperature conditions, which is traditionally difficult.

To further their research, Prof Loh and his team will study the supercritical behaviours of other fluids at high temperatures, and strive to derive a wider range of industrial applications.