Nanodiamonds synthesis under room conditions using AFM probe

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Natural diamonds are formed under high pressure and temperature conditions, deep within the Earth's mantle, where carbon atoms are arranged in a crystal lattice structure. In the laboratory diamonds can be obtained through two main methods: High Pressure High Temperature (HPHT) synthesis and Chemical Vapor Deposition (CVD) [1-2]. But these are all methods for producing large, 3D diamonds from 3D carbon blanks. If we move towards decreasing sizes and, in the limit, move to 2D materials, then in this case the key role in the transformation of several layers of graphite into diamond will be played not so much by temperature and pressure, but also by surface chemistry, interface and interlayers interactions, concentration of defects and local voltage distribution, which may be the key to the low-energy transition from sp^2 to sp^3 transition[3].
Also, over the past decade, progress has been made in the synthesis of other van der Waals 2D materials, from which it is also potentially possible to synthesize diamond-like structures with new intrigue properties that can be used in many applied problems [4-5].
Here is an overview of various measurements made with a diamond-coated AFM probe for different numbers of graphene and boron nitride layers. The force that the probe can exert on a surface can vary from pN to tens of nN. However, the probe radius can be quite small ~ 1 nm. With such a probe radius, the pressure exerted on the surface can reach potentially 10 GPa or even more, which could be sufficient for the synthesis of nanodiamonds or diamond like structures even at room temperatures.

References

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Figures

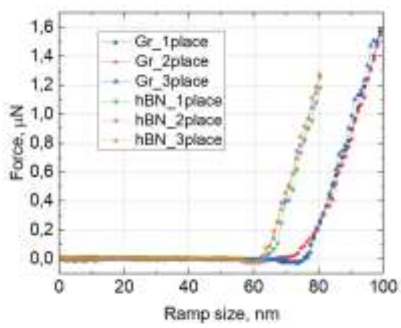

Figure 1: Force-distance dependencies obtained with diamond coated AFM probe for Graphite and hBN samples.