Piezoelectricity in monolayer hexagonal boron nitride

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Two-dimensional (2D) hexagonal boron nitride (hBN) is a wide-bandgap van der Waals crystal with a unique combination of properties [1]. Furthermore, in recent years hBN crystals have become the material of choice for encapsulating other 2D crystals in a variety of technological applications [2]. Monolayer hBN was predicted to exhibit piezoelectric properties because it has no center of symmetry, however experimental evidence was lacking. In this work, we used AC Bias electrostatic force microscopy (EFM) to observe this effect [3] as a strain-induced change in the local electric field around bubbles and creases, in agreement with theoretical calculations. No piezoelectricity was found in bilayer and bulk hBN, where the center of symmetry is restored. Our results add piezoelectricity to the known properties of monolayer hBN, which makes it a desirable candidate for novel electromechanical and stretchable optoelectronic devices, and pave a way to control the local electric field and carrier concentration in van der Waals heterostructures via strain. The experimental approach used here also shows a way to investigate the piezoelectric properties of other materials on the nanoscale by using electrostatic scanning probe techniques.

References

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Figures

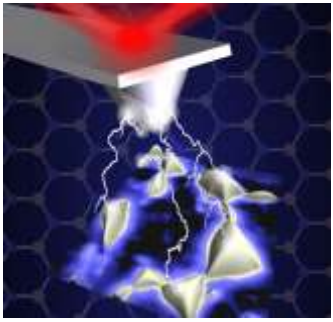

Figure 1: strain-induced change in the local electric field observed around bubbles in monolayer hBN