Original ways to large h-BN single crystals and derived nanosheets

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Prompted by the rising star of graphene, 2D nanomaterials are now a hot issue in the scientific world. Among them, h-BN nanosheets (BNNSs) are particularly relevant. Actually, BNNS has shown to be an excellent gate dielectric support for graphene owing to its atomically smooth surface, high thermal conductivity and stability combined with high mechanical strength. Compared with conventional SiO2 substrate, lattice matching and absence of dangling bonds make BNNS and graphene excellent pairing materials and give incentive to develop various VdW heterostructures. However, it has to be mentioned that such applications cannot be reach without high purity large BNNSs.
To achieve high quality and large BNNSs, we propose novel synthesis ways by the Polymer Derived Ceramics route involving polyborazylene as precursor, combined with sintering techniques. [1,2] These promising approaches allow synthesizing pure and well-crystallized h-BN single crystals, which can be easily exfoliated into BNNSs with lateral size over hundreds of microns. Here we present recent investigations on how to optimize processes, considering the influences of both sintering temperature and crystallization promoter ratio on h-BN. Structural studies were led by TEM and Raman spectroscopy. Both methods evidence a very high crystalline quality attested by the LWHM value, 7cm^{-1}, as the best reported in literature. [3] More original characterizations were performed by cathodoluminescence and XPS to prove the high BNNSs purity from both structural and chemical point of view. As a final application purpose, physical measurements have confirmed that derived BNNSs exhibit an interesting dielectric constant of 3.9 associated with a dielectric strength of 0.53 V/nm.

References

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Figures

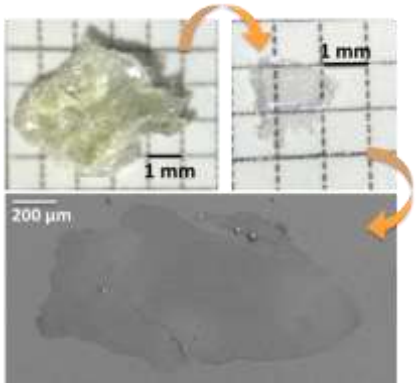

Figure 1: Millimeter-scale hexagonal-boron nitride single crystals as ample supply for 2D heterostructures