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BNNS: Boron Nitride NanoSheets from large and highly-crystallized h-BN nanocrystals synthesized by a polymer route combined with a sintering process

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Prompted by the rising star of graphene, 2D nanomaterials are now a hot issue in the scientific world. Among them, the h-BN nanosheet (BNNS), consisting of thin atomic layers made of B and N atoms covalently bounded, is particularly relevant. Actually, BNNS has shown to be an excellent gate dielectric support for graphene and other two-dimensional materials owing to its atomically smooth surface, high thermal conductivity and stability combined with high mechanical strength. Compared with conventional SiO_2 substrate, lattice matching and absence of dangling bonds make BNNS and graphene excellent pairing materials and give the incentive to develop various Van der Waals heterostructures. However, it has to be pointed out that such applications cannot be put into use without high purity large BNNSs. In order to achieve high quality and large BNNSs, we propose a novel synthesis way by the Polymer Derived Ceramics (PDCs) route involving polyborazylene as a precursor, combined with the Spark Plasma Sintering (SPS). This promising approach allows synthesizing pure and well-crystallized h-BN flakes, which can be easily exfoliated into BNNSs. Here we present recent investigations on how to optimize the process, considering the influences of both sintering temperature (1200°C to 1950°C) and crystallization promoter ratio (0 to 10wt%) 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 the literature. More original characterizations were carried out by cathodoluminescence to prove the high BNNSs purity from both chemical and structural point of view.

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