Electronic Supplementary Information

Facile fabrication of boron nitride nanosheets/amorphous carbon hybrid film for optoelectronic applications

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Content

SI1. Experimental details

Preparation of h-BN Nanosheet Aqueous Dispersions

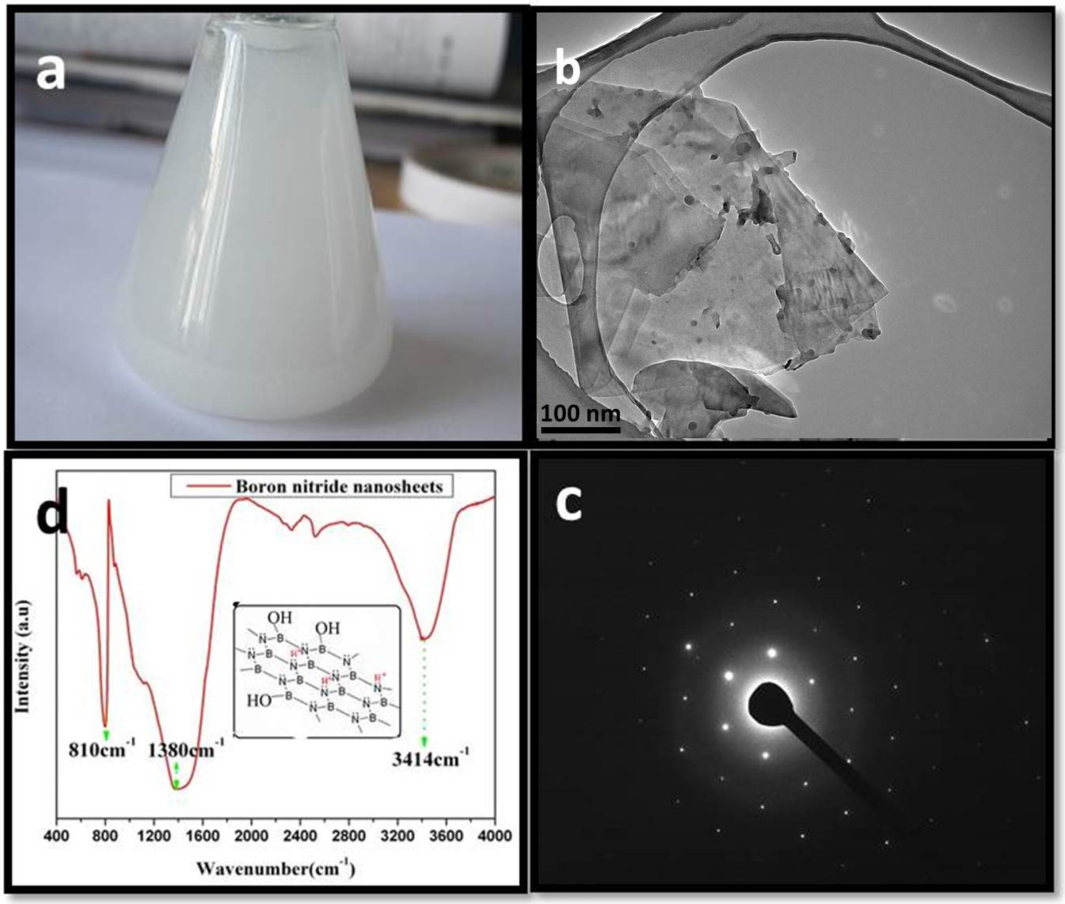
The pristine h-BN powder (50 mg) was sonicated in deionized water (500ml) using a bath sonicator (Branson 2510, 40 kHz) for 2 h. The resulting suspension was centrifuged at ~3000g (IEC Clinical Centrifuge). The supernatant was passed through a coarse filter paper (Whatman cellulose) and the filtrate was collected as the "clean" aqueous dispersion of *h*-BN nanosheets, and dried at 50^{o}C.

Synthesis of B-C-N ternary films by the electrolysis

The obtained BNNS was ultrasonically dispersed in methanol solvents to obtain homogeneous 0.05mg/ml BNNS suspension as the electrolyte. The electrolysis of the BNNSs/methanol electrolyte is performed under the electric field of 2400 V/cm and at 60 ± 5^{o}C, where the cathode and anode are silicon substrate and Pt sheet, respectively. Finally a uniformly grey film with the thickness of about 1000 nm is obtained on the silicon substrate.

SI2 Characterization of the obtained BNNS

The obtained *h*-BNNSs in water (~0.1 mg/ml) showed a milky white color, observed by the camera, especially this homogenous dispersion was stable and only a few of precipitation. The obtained h-BNNSs have an average grain size of around 250 nm, determined by transmission electron microscopy (TEM). The selected area electron diffraction (SAED) pattern corresponds to (100) plane and (002) plane of h-BN, respectively. Two strong peaks at 1380 cm^{-1} and 810 cm^{-1} of Fourier transform infrared spectroscopy (FTIR) are the in-plane stretching of B-N rings and out-of-plane bending vibration of B-N-B rings of sp2-hybridized, respectively, typical characteristics of h-BN. Further, a peak of ~3414 cm^{-1} is attributed to the stretching signal of O-H.



SI3 Mechanical characterization of the films

A NanoTest 600 nanomechanical system (MicroMaterials Ltd, UK) equipped with a diamond probe was conducted to gain knowledge of the Young's modulus and nanohardness of the a-C and B-C-N films, with a maximum load of 200μN and an indentation depth of 16.3nm (less than 10% of film thickness) so as to minimize the effect of substrate. The hardness and the moduli elastic value of films were derived from the indentation unloading curves through automatic data analysis, according to Oliver–Pharr calibration technique. As a result, a-C film shows the nanohardness of 2.35GPa and the Young's modulus of 44.35GPa, while B-C-N film has the nanohardness of 5.76 GPa, and the Young's modulus of 105.90 GPa.