Supporting Information

Vortex fluidic exfoliation of graphite and boron nitride

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A systematic evaluation of the effect of different inclination angles and rotational speeds

Firstly, experiments with the tilt angle θ set at 0°, 15°, 30°, 45°, 60°, 75° and 90° were carried out with rotational speeds at 3000 rpm, 6000 rpm, and 9000 rpm, with the concentration and volume of the graphite/NMP suspension fixed at 0.1 mg/mL and 1 mL, respectively. TEM established that θ = 45° resulted in the greatest reduction in the average thickness of the graphite flakes. The inclination angle θ plays an important role in controlling the microfluidic conditions inside the rotating tube. At low angles, there will be a circular flow along the inside wall of the tube in the tangential plane, and flow velocity components along the length of the tube will be weak with laminar flow. At high angles, the flow velocity components along the length of the tube are high (turbulent flow). However, a large amount of graphite flakes stay at the bottom of the tube, but this doesn't occur at θ = 45°. We therefore fixed θ at this angle to disperse the flakes under turbulent flow, and subsequently varied the speed to optimise the graphite exfoliation process. Speeds in excess of 6000 rpm resulted in more exfoliation of the graphite flakes, with the highest yield of graphene at 7000 rpm. Beyond this speed the yield drops appreciably.

Determining the average liquid film thickness inside the rotating tube

The internal surface area of the liquid with different rotating speeds and inclination angles was measured by using a colour-dyed water in a scale-marked tube, for 1 mL of water. By recording the position of the colour-dyed water in the tube, the internal surface area covered by the liquid can be obtained. The film thickness, d, is then determined from the estimated internal surface area of the tube and the liquid volume V: d = V/area.

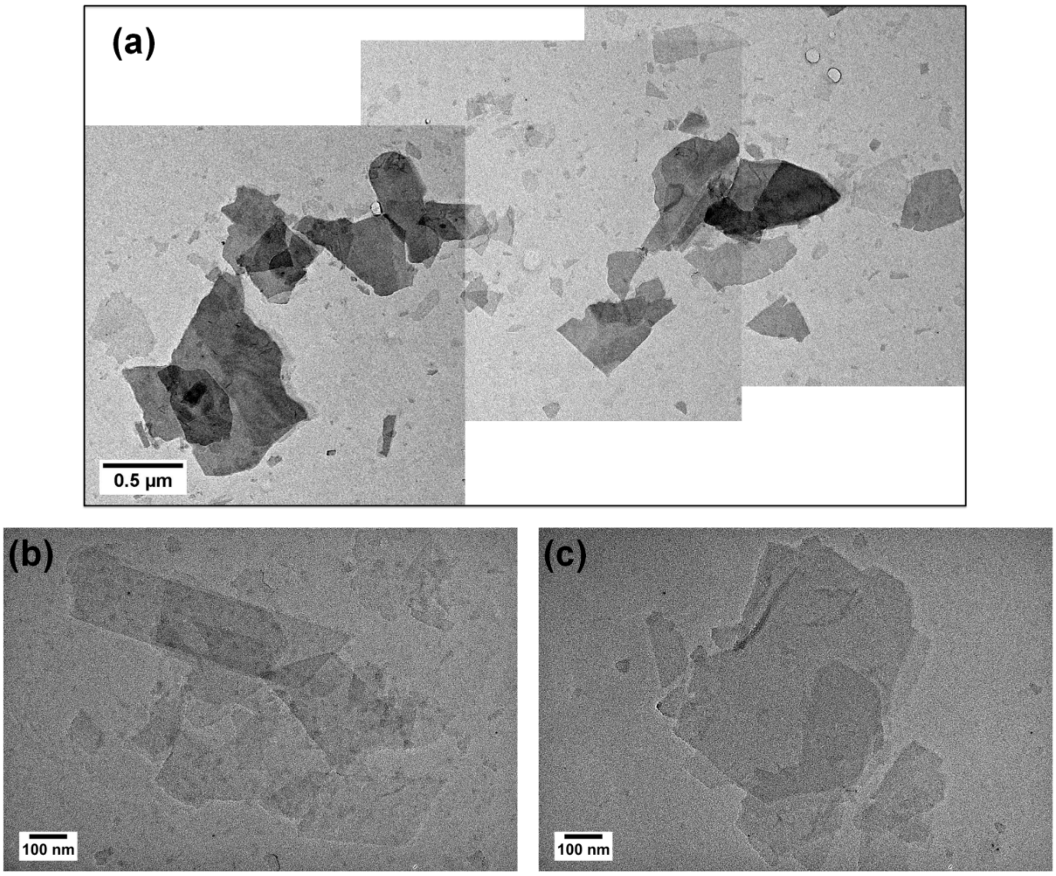

Figure S1 TEM images, (a) – (c), of graphene and partially exfoliated graphene in NMP using the vortex fluidic device.

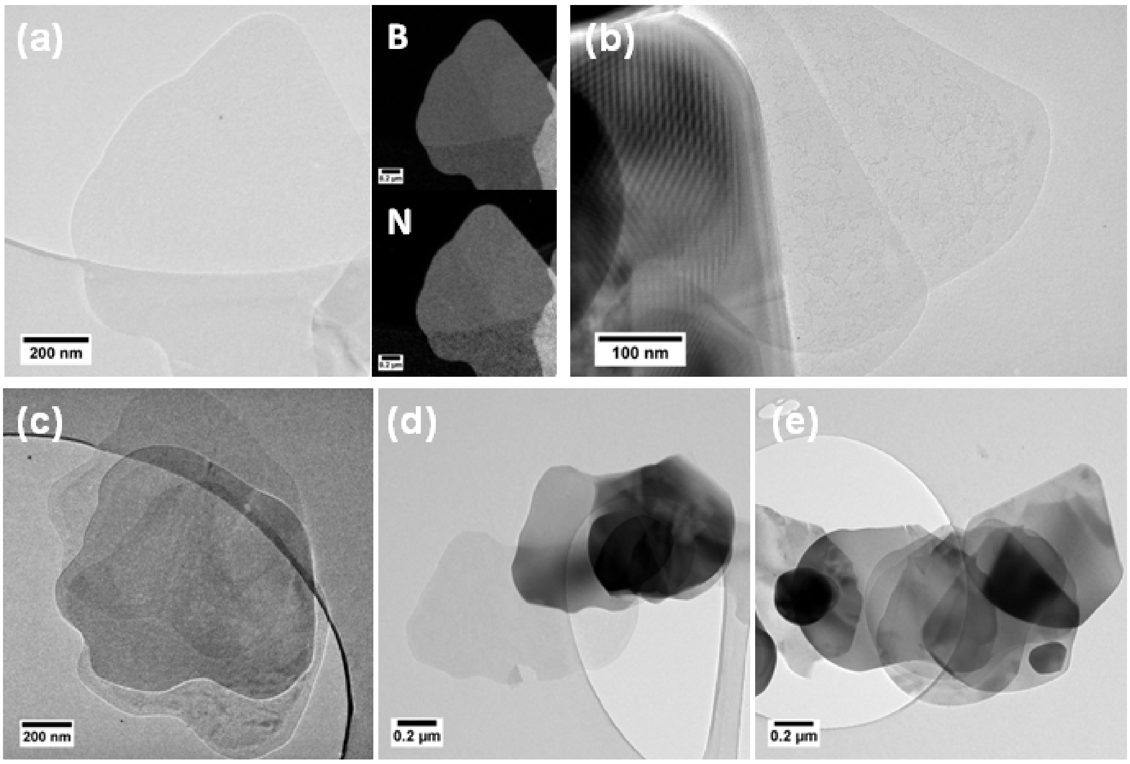

Figure S2 (a) TEM image of a mono-layer BN sheet with corresponding element mappings. (b)-(e) TEM images of partially exfoliated BN sheets with the same outline (Finger print).

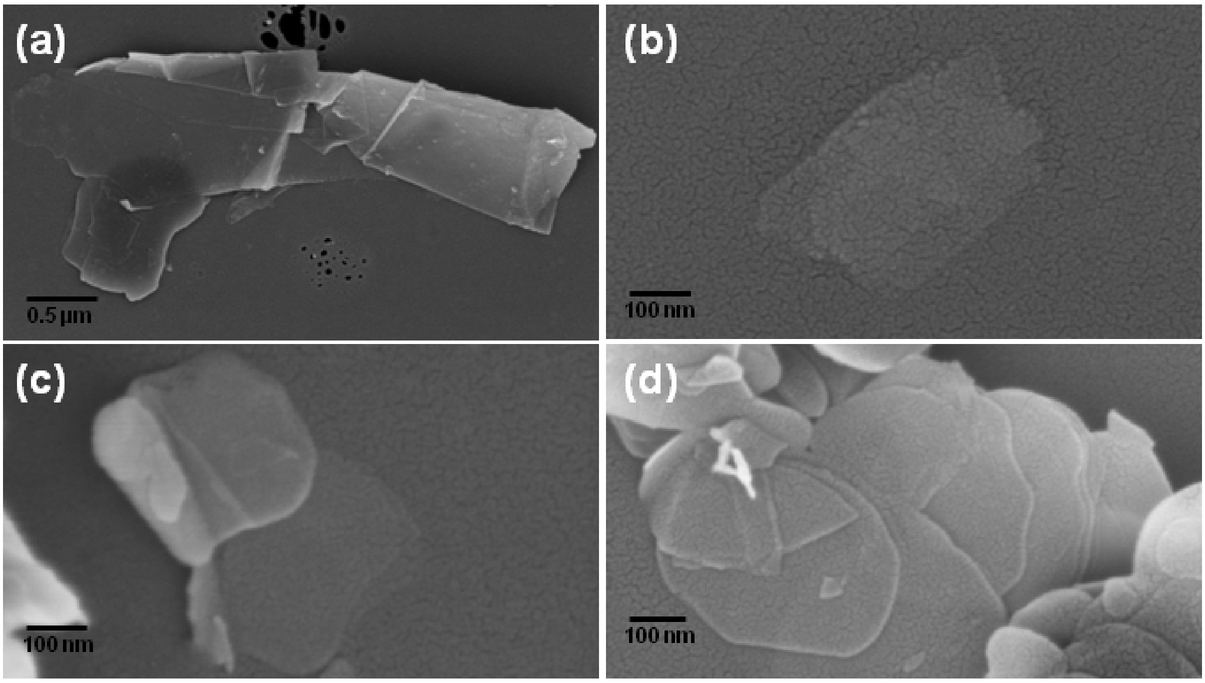

Figure S3. SEM images of graphene sheets (a and b) and boron nitride sheets (c and d)