

Dynamic thin film mediated slicing of boron nitride nanotubes

Ahmed Hussein Mohammed Al-antaki^{a,b}, Warren Lawrance^c, Colin L. Raston^{*a}

- a- Flinders Institute for Nanoscale Science and Technology, College of Science and Engineering, Flinders University, Adelaide, SA 5042, Australia.
- b- Department of Chemistry, Faculty of Sciences, Kufa University, Kufa, Najaf, Iraq.
- c- College of Science and Engineering, Flinders University, Adelaide, SA 5042.

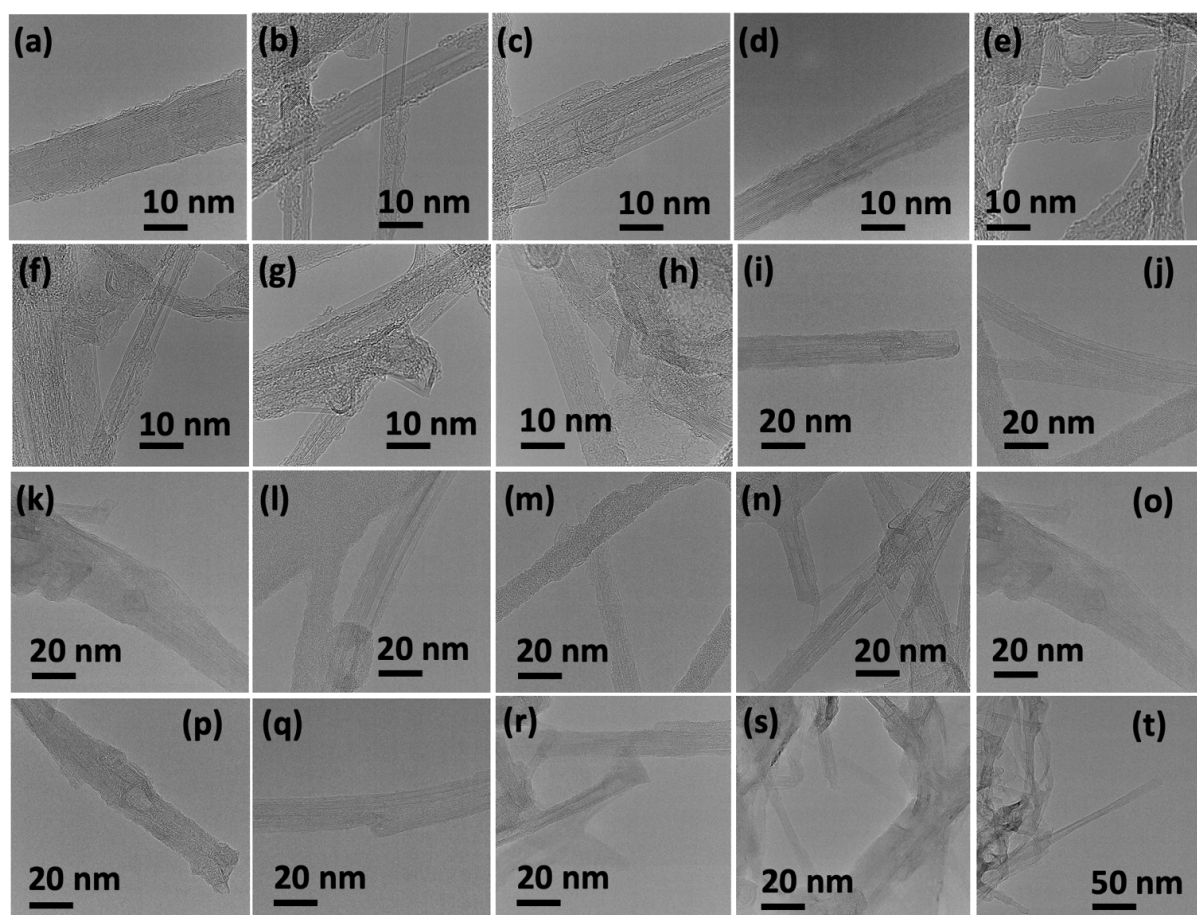


Figure S 1. HRTEM images of drop cast BNNTs after purification the as received material, after 2.5 h at 60°C followed by 3 h stirring in IPA and water (1:3) at 100°C.

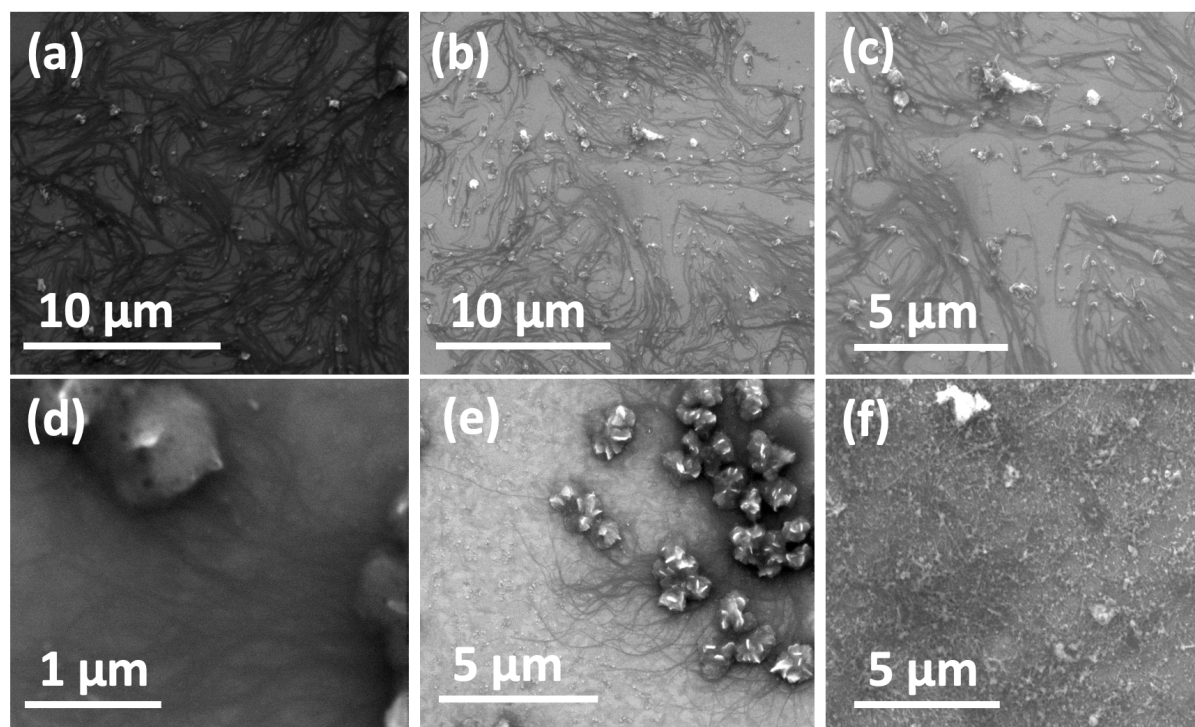


Figure S 2. SEM images for drop cast of BNNTs (0.1 mg/mL) in toluene and water (1:1) rotational speed 7.5k rpm, confined mode for 1 h while irradiated with a 280 mJ NIR pulse laser. (a-c) pH of water 9. (d, e) pH of water 10. (f) pH of water 5.

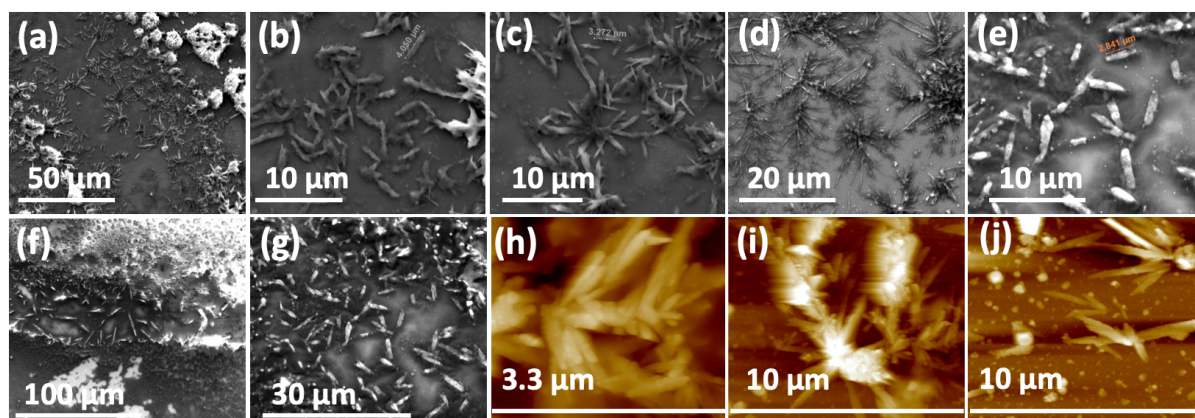


Figure S 3. Drop cast BNNTs (0.1 mg/mL) in toluene and THF (1:1), flow rate 0.1 mL/min, flow rate of water at pH= 9 0.15 mL/min, rotational speed 7.5k rpm, 280 mJ NIR, 45° tilt angle. (a-d) SEM images for aqueous phase. (e-g) SEM images for evaporated organic phase. (h-j) AFM images of the evaporated aqueous phase.

First method :-

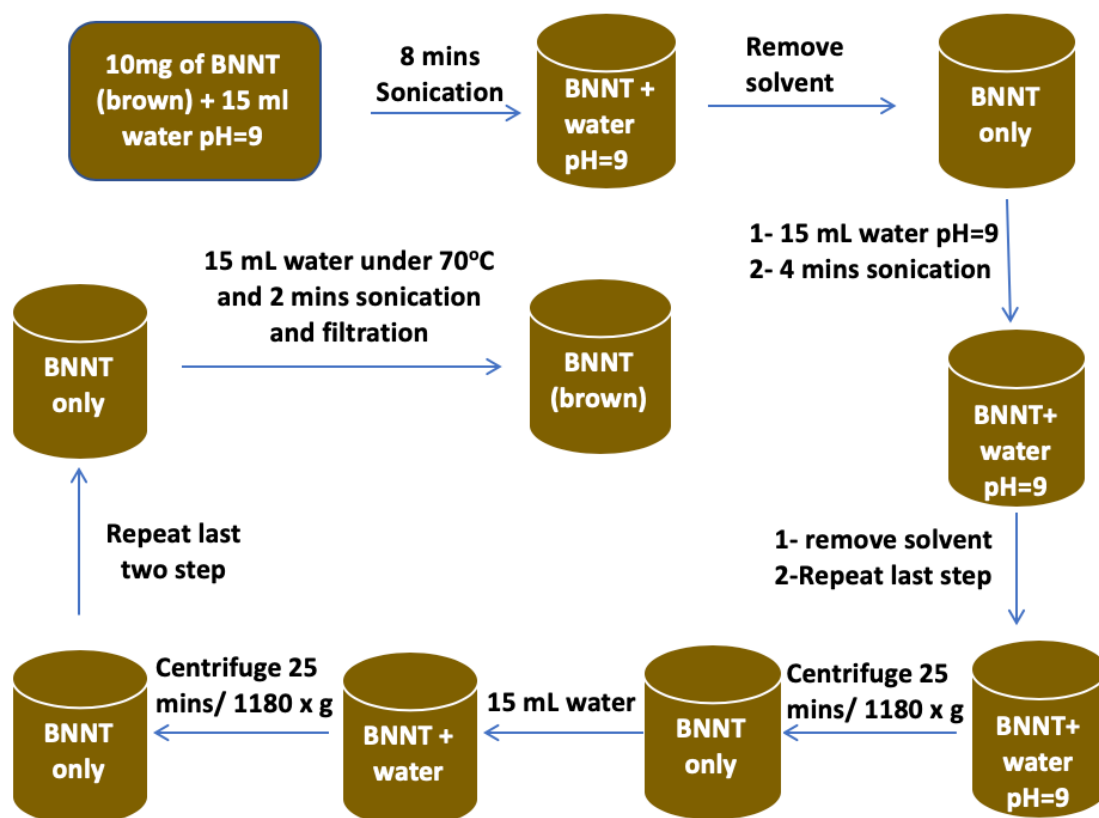


Figure S 4. First step used to remove the impurities in as received BNNTs.

second method :-

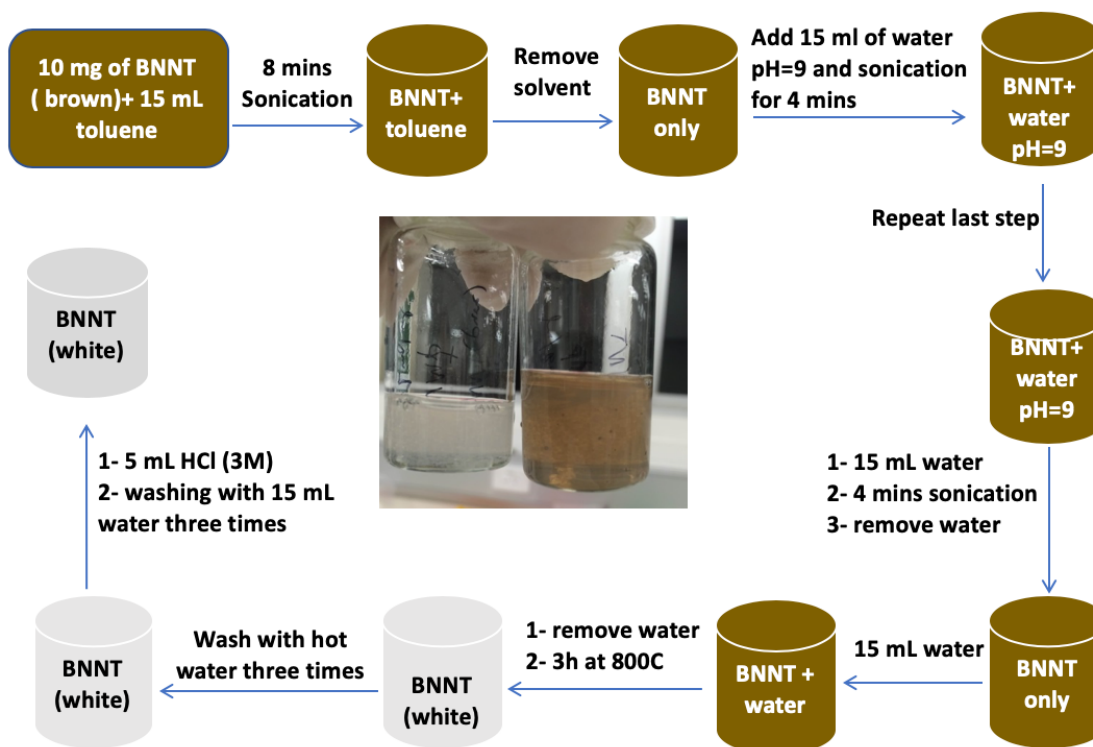


Figure S 5. Second processing step 2 to purify as received BNNTs.

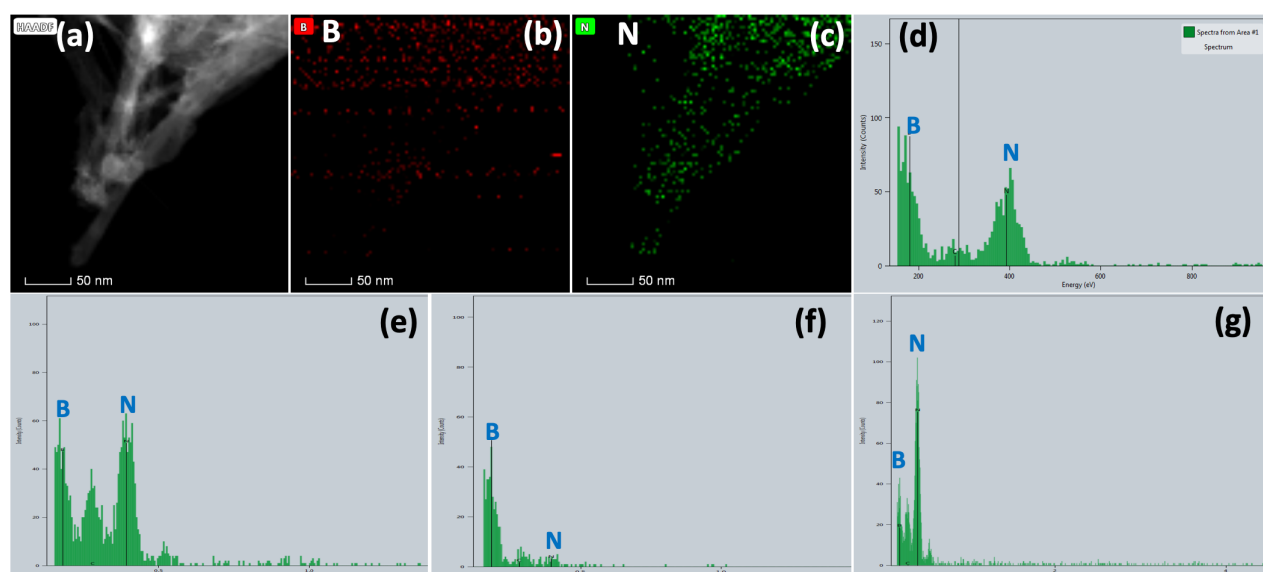


Figure S 6. Purified BNNTs after 2.5 h at 60°C followed by 3 h stirring in IPA and water (1:3) at 100°C. (a-c) EDS mapping of purified BNNTs associated with HRTEM. (d) EDS spectrum. (e-g) EDS using HRTEM at different locations.

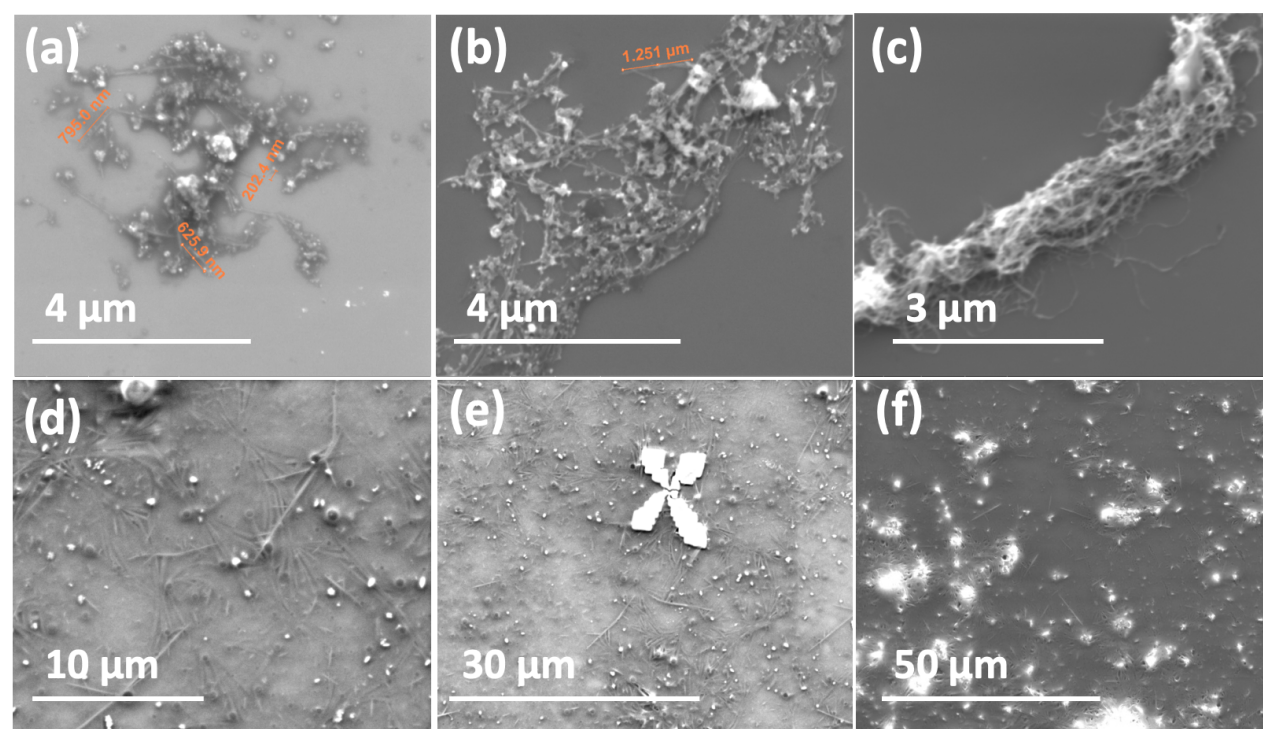


Figure S 7. SEM images of drop cast BNNTs (0.1 mg/mL) in IPA and water (1:1), rotational speed 7.5k rpm, flow rate 0.1 mL/min, 45° tilt angle. (a-c) Green laser processing (532 nm), 260 mJ. (d-f) NIR laser (1062 nm), 600 mJ.

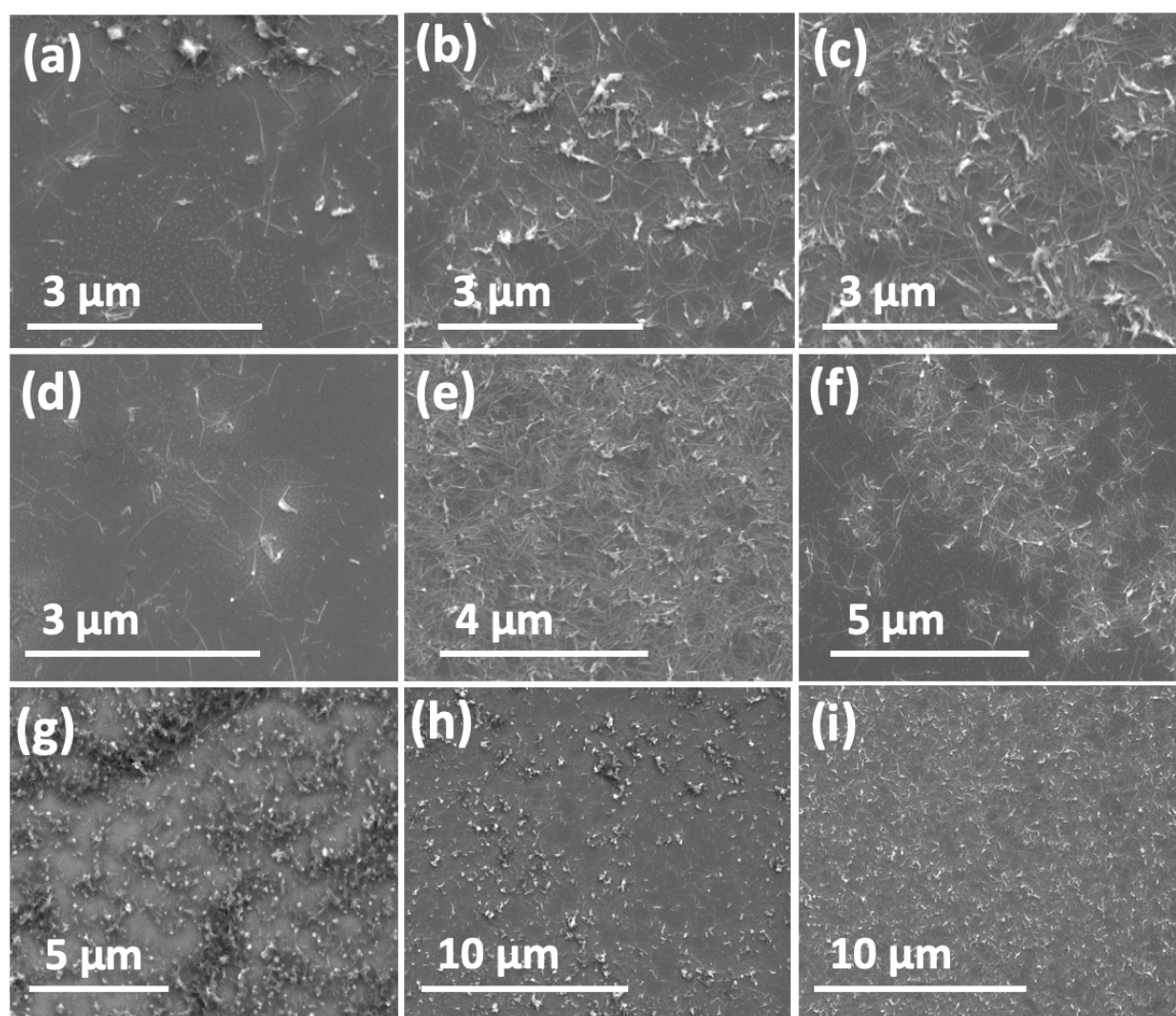


Figure S 8. SEM images of drop cast BNNTs in IPA and water (1:1) after processing in a VFD with 400 mJ NIR laser irradiation, concentration 0.1 mg/mL, flow rate 0.45 mL/min, rotational speed 8.5k rpm and 45° tilt angle.

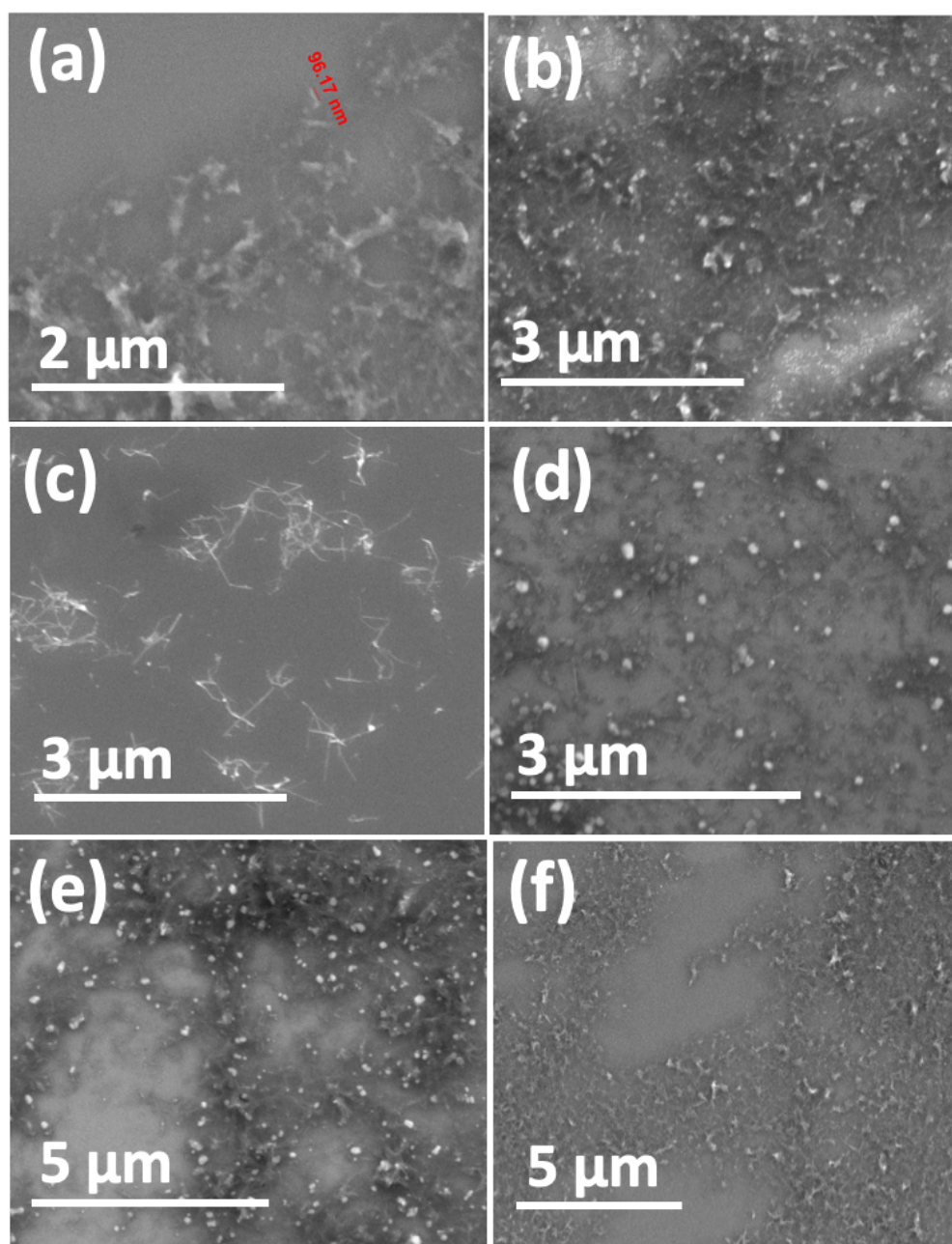


Figure S 9. SEM images for drop cast BNNTs prepared in IPA and water (1:1) after processing in a VFD while irradiated with 600 mJ NIR laser, concentration 0.1 mg/mL, flow rate 0.45 mL/min, rotational speed 8.5k rpm and 45° tilt angle.

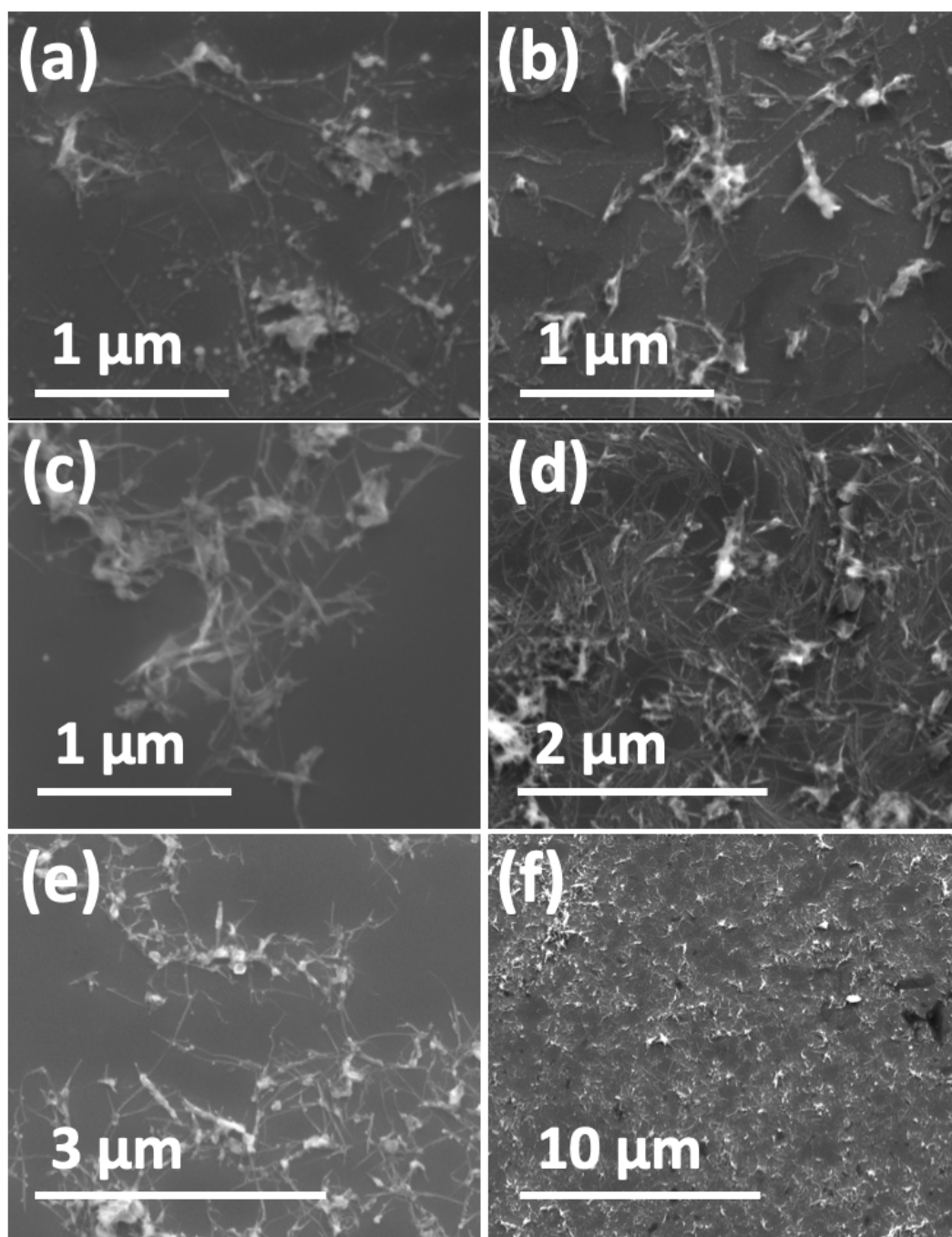


Figure S 10. SEM images of drop cast sliced BNNTs in IPA and water (1:1) after processing in the VFD with a pulsed laser operating at 1064 nm and 250 mJ, concentration 0.1 mg/mL, flow rate 0.45 mL/min, rotational speed 8.5k rpm and 45° tilt angle.

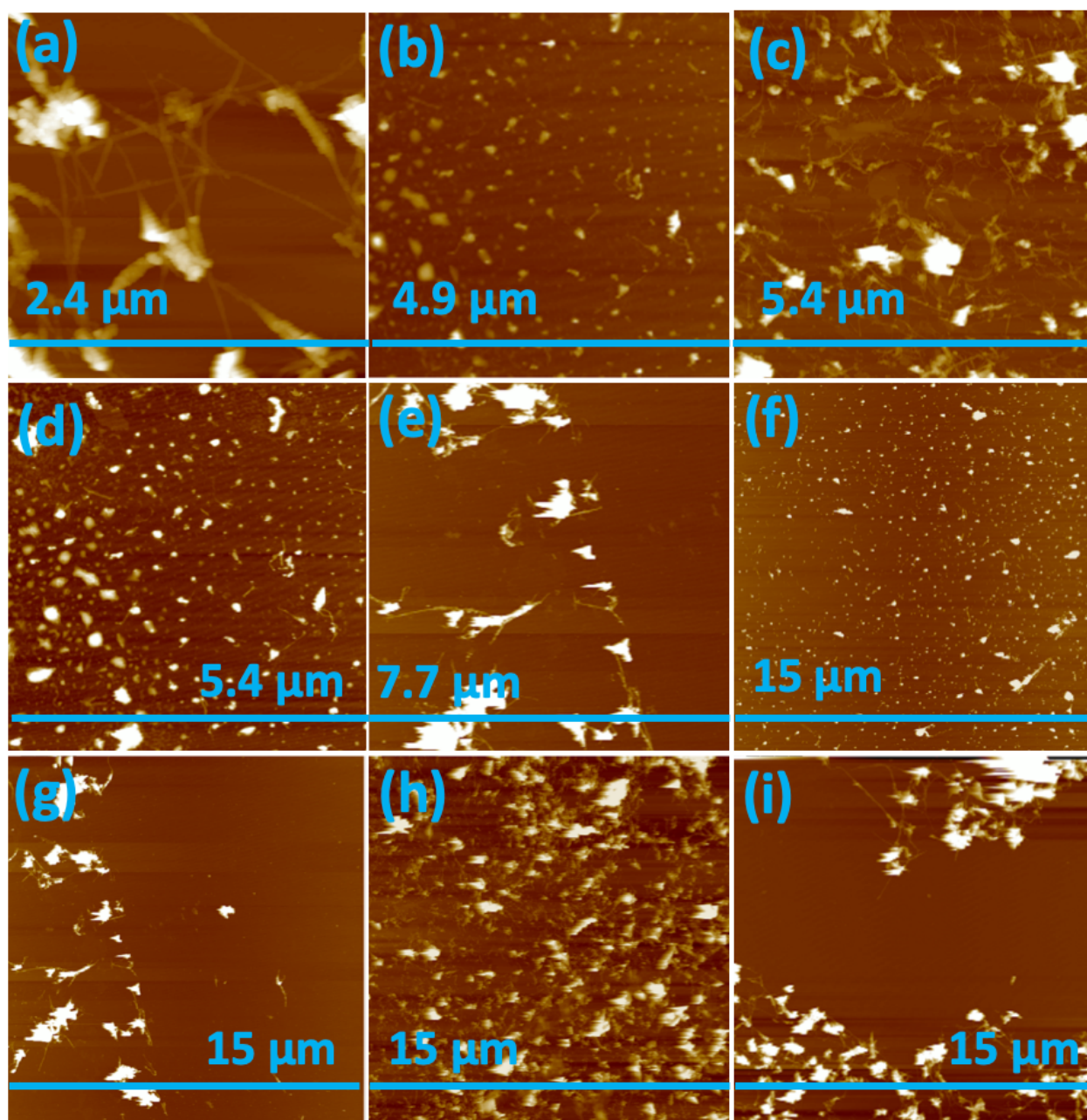


Figure S 11. AFM images for drop cast sliced BNNTs prepared in IPA and water (1:1) after processing in the VFD with a pulsed laser operating at 1064 nm and 250 mJ, concentration 0.1 mg/mL, flow rate 0.45 mL/min, rotational speed 8.5k rpm and 45° tilt angle.

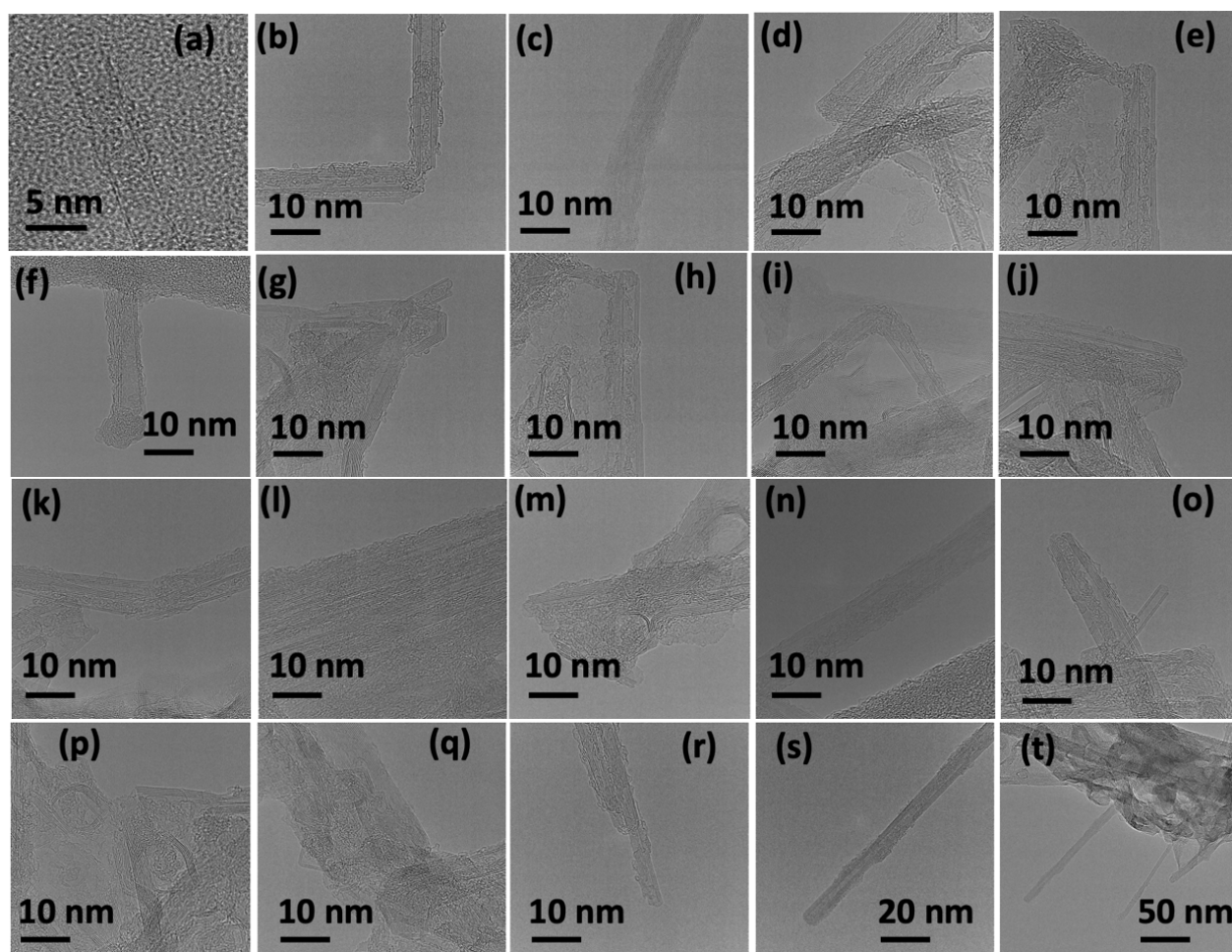


Figure S 12. HRTEM images of drop cast sliced BNNTs in IPA and water (1:1) after processing in the VFD with a pulsed laser operating at 1064 nm and 250 mJ, concentration 0.1 mg/mL, flow rate 0.45 mL/min, rotational speed 8.5k rpm and 45° tilt angle.

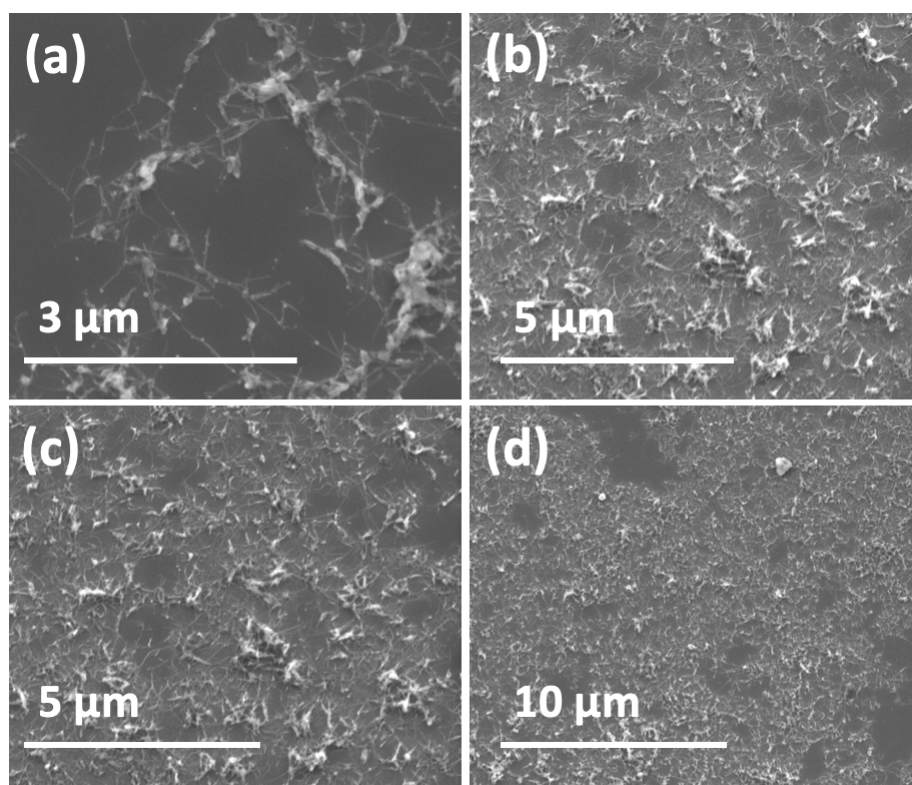


Figure S 13. SEM images for drop cast of BNNTs in IPA and water (1:1) after processing in a VFD, concentration 0.1 mg/mL, flow rate 0.45 mL/min, rotational speed 8.5k rpm with 45° tilt angle.

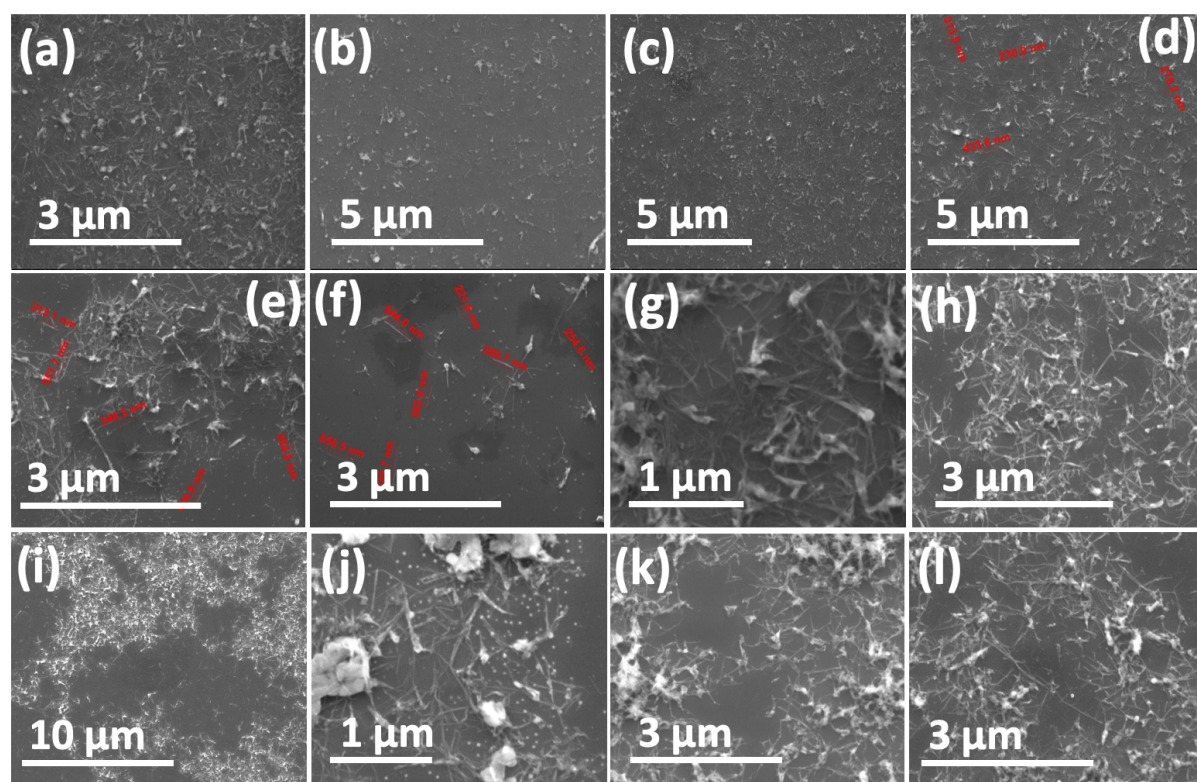


Figure S 14. SEM images for drop cast of BNNTs (0.1 mg/mL) after processing in a VFD while irradiated with a 250 mJ NIR laser, flow rate 0.45 mL/min and 45° tilt angle. (a-c) DMF as the solvent, rotational speed 6k rpm. (d-f) DMF as the solvent, rotation speed 8.5k rpm. (g-i) DMF and water (1:1) as the solvent, rotational speed 8.5k rpm. (j-l) Water as the solvent, rotational speed 8.5k rpm.

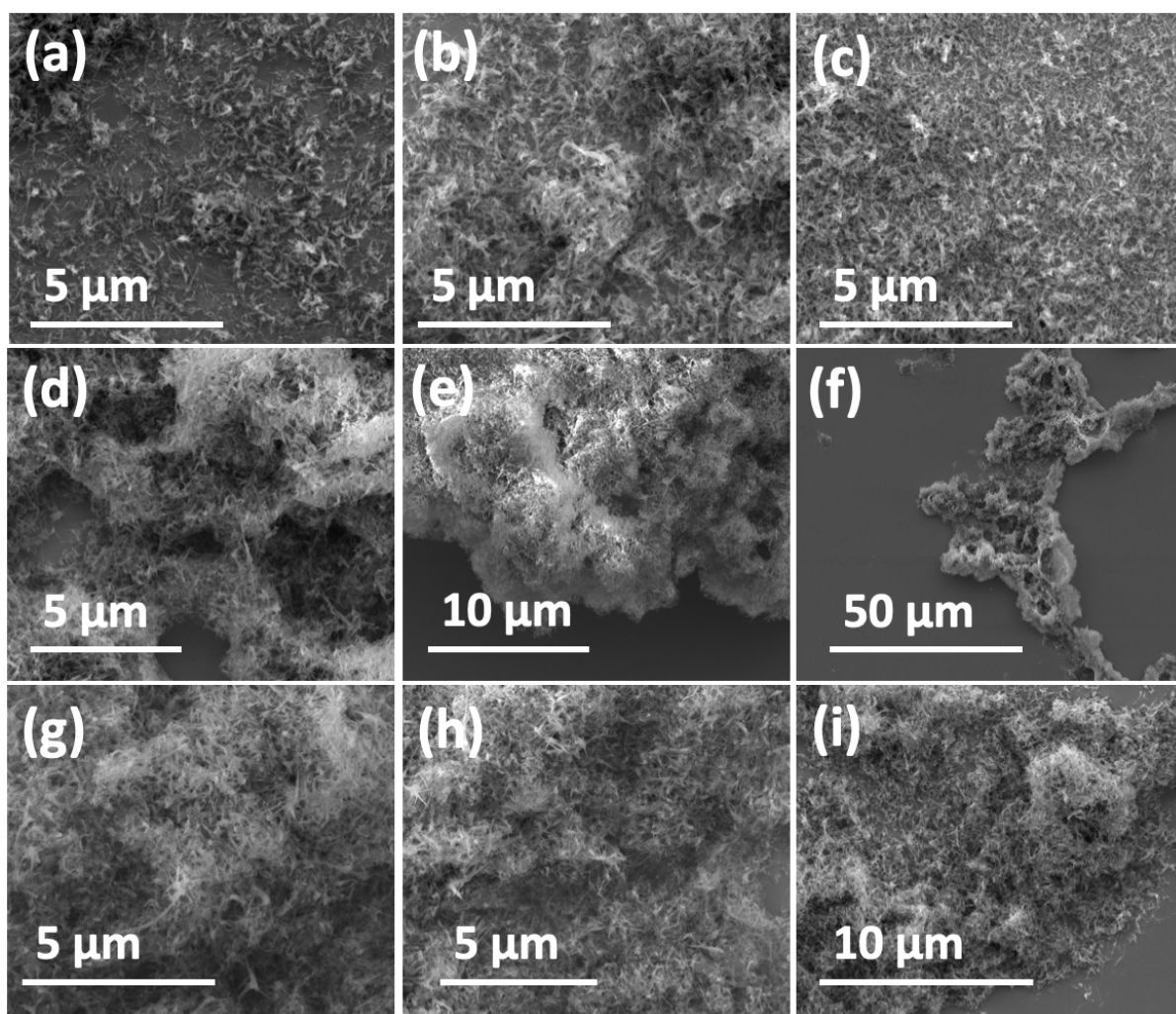


Figure S 15. SEM images for drop cast of BNNT (0.2 mg/mL) in toluene and water (1:1) after sonication for 30 mins, with 1 mL of the milky suspension used in the confined mode of operation of the VFD for 15 mins, 45° tilt angle. (a-c) Rotational speed 4k rpm. (d-f) Rotational speed 6k rpm. (g-i) Rotational speed 8k rpm.

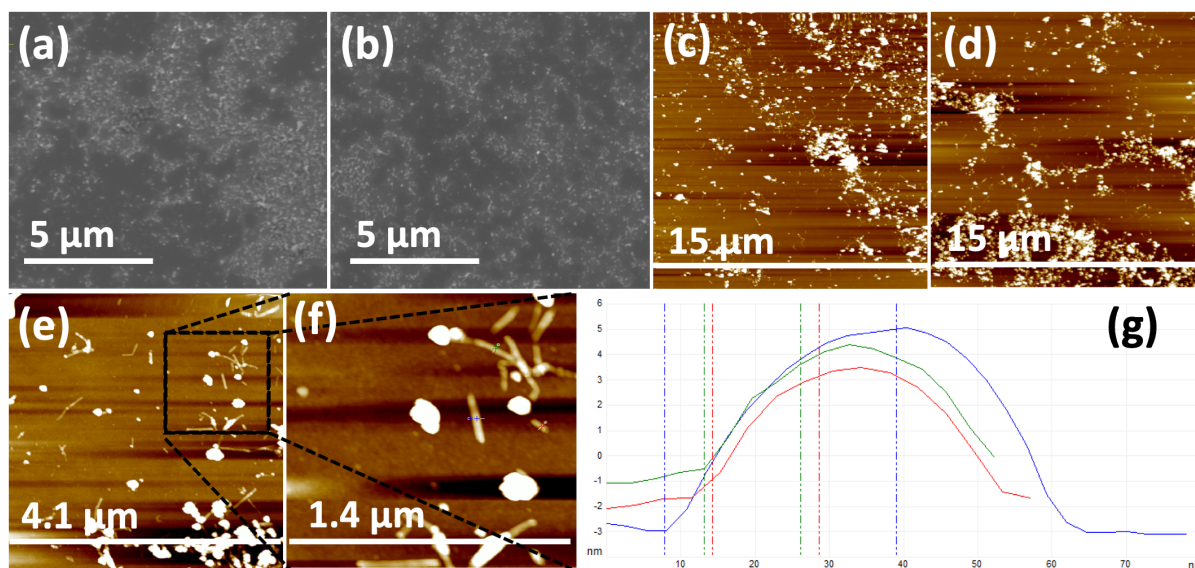


Figure S 16. Drop cast of BNNTs in water (0.1 mg/mL) after VFD processing, flow rate 0.3 mL/min, rotational speed 7.5k rpm and 600 mJ NIR laser, with the tube at 45° tilt angle. (a, b) SEM images. (c-f) AFM images. (g) Height of three tubes measured from AFM images.

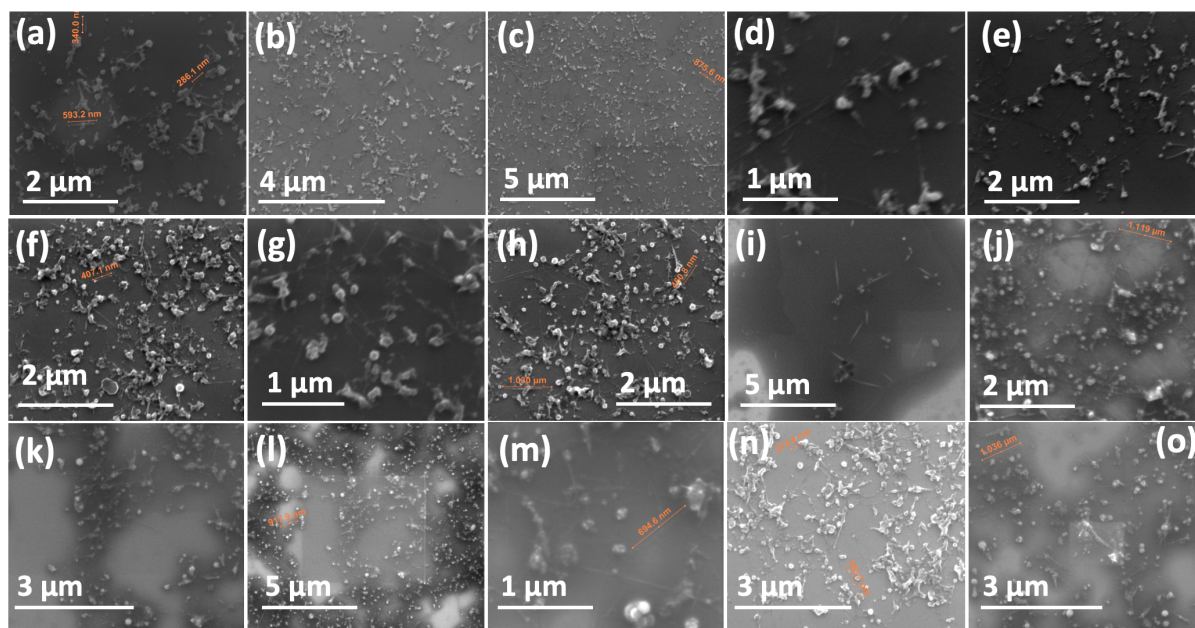


Figure S 17. SEM images for drop cast BNNTs (0.1 mg/mL) in NMP, rotational speed 7.5k rpm, confined mode, 45° tilt angle. (a-c) 10 min, 280 mJ NIR laser irradiation. (d-f) 30 mins, 280 mJ NIR laser irradiation. (g-i) 1 h, 280 mJ NIR laser irradiation. (j-l) 30 mins, 400 mJ NIR laser irradiation. (m-o) 1 h, 400 mJ NIR laser irradiation.