

Supplementary Information

Nitrate uptake using *p*-phosphonic acid or *p*- (trimethylammonium)methyl calix[8]arene stabilized lamellar materials

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1. Synthesis

Preparation of *p*-(dimethylamine)methyl-calix[8]arene

Calix[8]arene (1.0 g, 0.0012 moles) was suspended in DMF (25 mL). Acidic acid (3 mL), 33% dimethylamine in ethanol (2.5 mL) and 37% formaldehyde (1 mL) were then added. The mixture was stirred at room temperature for 24 hrs. The mixture was brought to dryness under reduced pressure and resuspended in MillQ water (15 mL). The solution was then neutralised using 10 % potassium carbonate and the solid was collected by centrifuge at 3000 x g for 10 minutes, resuspended in MillQ water and centrifuged at 3000 x g for 10 minutes, resuspended in methanol and centrifuged at 3000 x g for 10 minutes. The product was then dried under high vacuum (1.06 g, 66 %).

¹H NMR (DMSO, 600.1 MHz) δ_{H} : 2.13 (s, 48H), 3.26 (s, 16 H), 3.77 (s, 16 H), 6.88 (s, 16H).

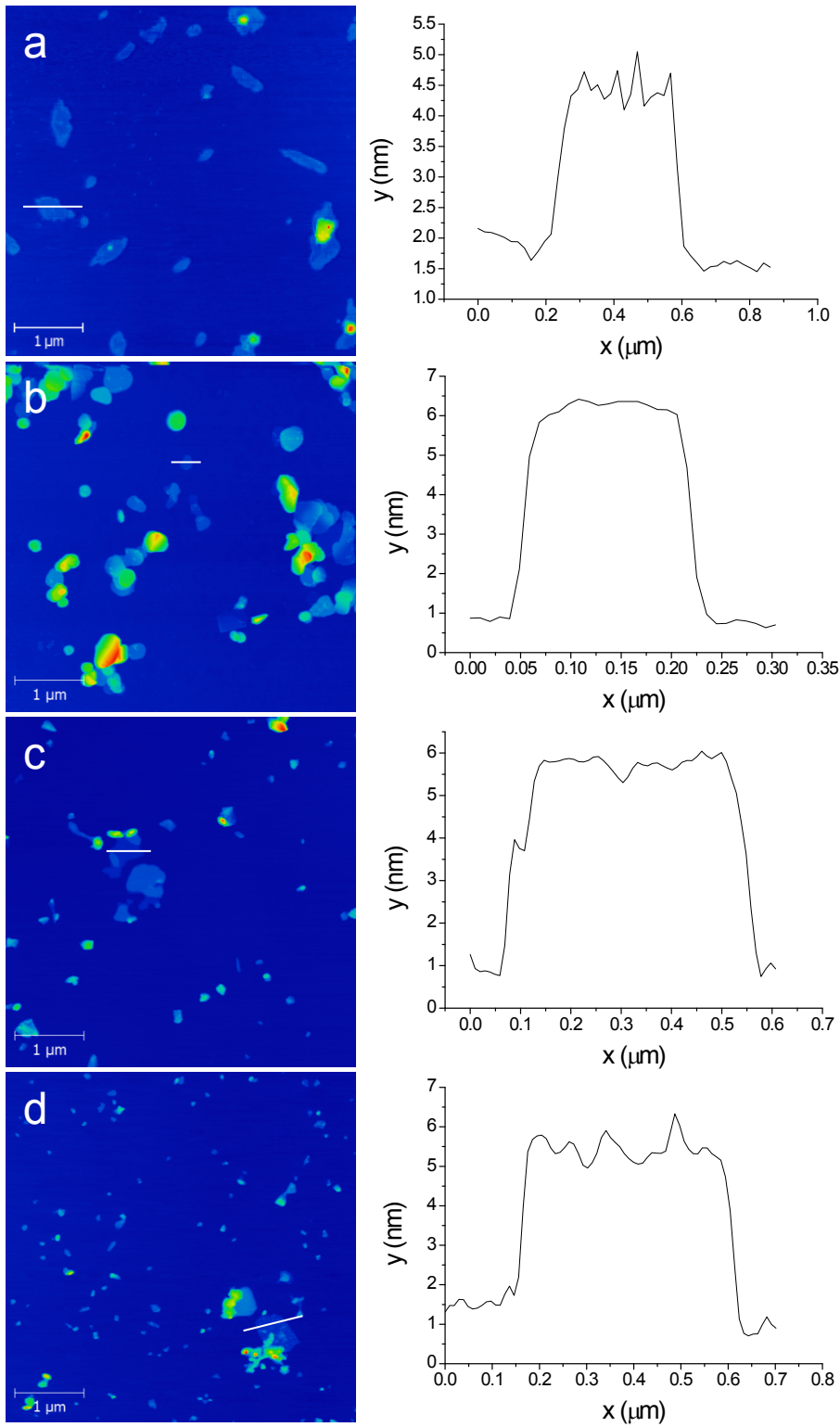
¹³C NMR (DMSO, 150.9 MHz) δ_{C} : 33.0 (CH₂), 44.8 (CH₃), 63.5 (CH₂), 126.4 (Cq), 128.9 (Cq), 129.2 (CH), 154.8 (Cq).

Preparation of *p*-(trimethylammonium)methyl-calix[8]arene

p-(dimethylamine)methyl-calix[8]arene (2.0 g, 0.0015 moles) was suspended in DMF (17 mL). Methyl Iodide (3.0 g, 0.021 moles), in DMF (3 mL) was then added. The mixture was stirred at room temperature for 4 hrs. The solution was then poured into 100 mL of acetone and filtered. The solid was then washed with acetone and allowed to dry (2.84 g, 76 %).

¹H NMR (DMSO, 600.1 MHz) δ_{H} : 2.93 (s, 72H), 3.85 (s, 16 H), 4.35 (s, 16 H), 7.14 (s, 16H).

¹³C NMR (DMSO, 150.9 MHz) δ_{C} : 32.5 (CH₂), 51.8 (CH₃), 68.5 (CH₂), 117.6 (Cq), 129.1 (Cq), 133.1 (CH), 157.3 (Cq).



Atomic force microscopy (AFM) images and line profiles of 2D materials exfoliated with *p*-phosphonic acid calix[8]arene. a) Graphene, B) BN, C) MoS₂, and D) WS₂.