Scalable synthesis of 2D BN: an atomically thin insulator, substrate, and encapsulation layer

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Abstract

Among the wide variety of 2D materials with properties including semiconducting, metallic, insulating, magnetic, ect., BN is one of the only wide band gap insulators that can be made atomically thin. As such 2D BN plays a critical role in numerous 2D devices as a dielectric gate, passivation layer, tunnelling barrier, and weakly interacting substrate [1,2] However, the majority of the BN used in these application are small area flakes produced by exfoliation from bulk sources. To achieve wafer scale 2D BN we have developed metal organic chemical vapour deposition processes to produce highly uniform few-layer BN layers that are atomically smooth (Fig. 1). We then apply these films as substrates for growth of III-nitrides and mechanical lift-off, weakly interacting substrates for 2D materials, and as encapsulation layers and top gate dielectrics in FETs (Fig2).

References

[1] SR Vangala, G Siegel, T Prusnick, M Snure, Scientific Reports 8 (2018) 8842
[2] L Yang, A Charnas, G Qiu, YM Lin, CC Lu, W Tsai, Q Paduano, M Snure, P Ye, ACS Omega 2, (2017) 4173.

Figures

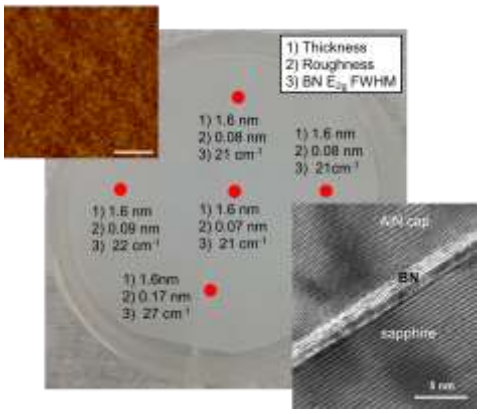

Figure 1: Few layer 2D BN grown on 2" sapphire by MOCVD. Measured thickness, roughness and FWHM of BN E_{2g} Raman mode across 5 points.

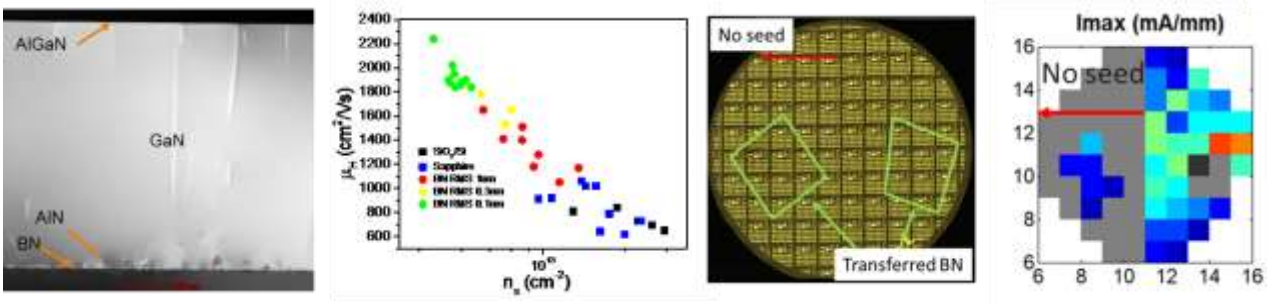

Figure 2: Application of MOCVD BN for GaN growth, graphene substrate, and top gate and encapsulation layer (left to right)