Planar and van der Waals heterostructures for vertical tunnelling single electron transistors

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Despite a rich choice of two-dimensional materials, which exists these days, heterostructures, both vertical (van der Waals) and in-plane, offer an unprecedented control over the properties and functionalities of the resulted structures. Here we demonstrate simultaneous use of in-plane and van der Waals heterostructures to build vertical single electron tunnelling transistors. We grow graphene quantum dots inside the matrix of hexagonal boron nitride, which allows a dramatic reduction of the number of localised states along the perimeter of the quantum dots. Utilising hexagonal boron nitride tunnel barriers as contacts to graphene quantum dots we produce reproducible transistors which are non-dependent on the localised states, allowing larger flexibility when designing future devices.

References

[1] G. Kim *et al.*, Nature Communications, 230 (2019)

Figures

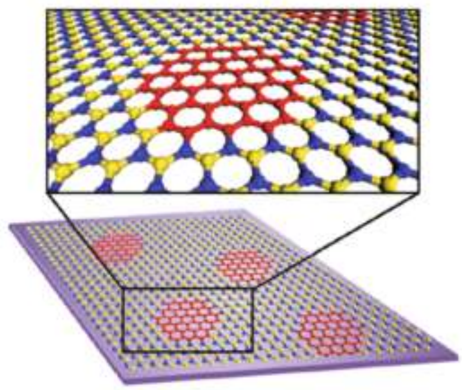

Figure 1: hBN embedded graphene quantum dots obtained through a Pt assisted catalytic conversion process

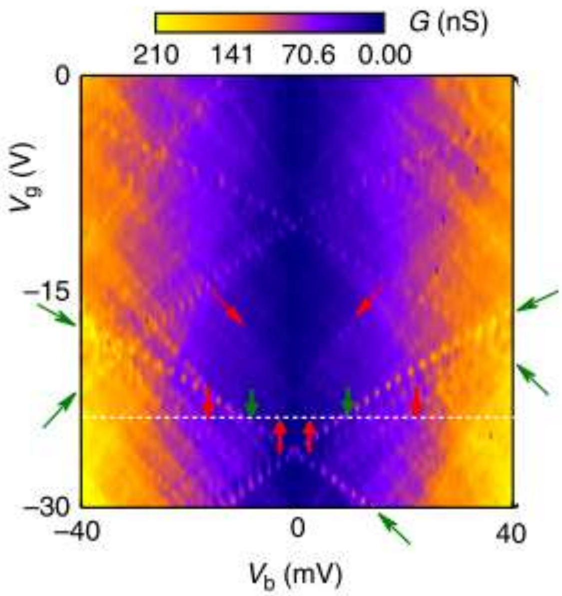

Figure 2: Coloumb diamonds observed through the transport measurements of the hBN embedded graphene quantum dots assembled into a van der Waals heterostructure with hBN tunnelling contacts.