LOW-DIMENSIONAL MATERIALS

2D devices turn on with a twist

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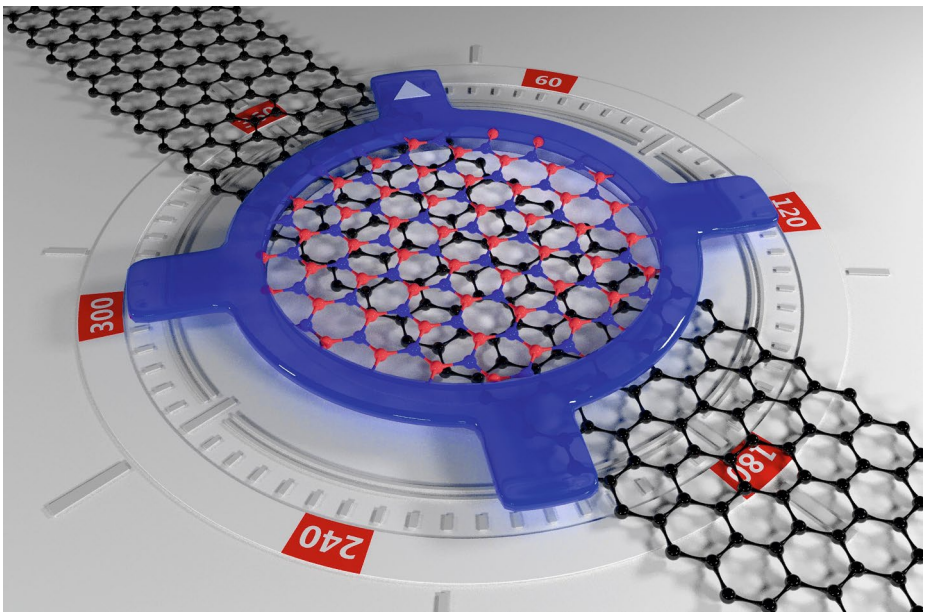

Credit: Philip Krantz/Krantz NanoArt

Electronic devices based on two-dimensional materials could potentially be used to replace, or compliment, bulk material-based electronics. Recent studies have shown that the rotational alignment between stacked two-dimensional layers can impact their electronic properties. However, difficulties in controlling the rotational alignment in such van der Waals heterostructures has so far limited the ability to exploit this phenomenon in electronic devices. Rebeca Ribeiro-Palau, Cory Dean and colleagues now demonstrate an approach that enables direct control of the orientation between 2D materials.

The researchers — who are based at Columbia University and the National Institute for Materials Science in Japan — fabricated a van der Waals heterostructure comprising a hexagonal boron nitride (h-BN)/graphene/h-BN sandwich. Due to the low friction between the layers, the uppermost layer of h-BN can be rotated using the tip of an atomic force microscope. By changing the rotational alignment in the structure, Dean and colleagues show that the bandgap in the graphene can be altered, and turned on and off as required. The approach provides a versatile platform to investigate the physical properties of two-dimensional materials, and also suggests that tunable electronic devices could be fabricated from just one material.

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