IBS Center for Multidimensional Carbon Materials

Special Seminar

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Observing while it happens: CVD growth of graphene inside a scanning electron microscope

September 14 **Thursday, 11 AM**	Bldg. 101 Seminar Room **412**

In my talk, I will demonstrate the potential of environmental scanning electron microscopy (SEM) and its application as in-situ surface science tool. After showing some examples of gas-phase induced reactions on metal substrates, I will focus on CVD growth of graphene, where direct observation has provided some valuable insights into the growth and etching behavior of single and multi-layer graphene.[1-3]

Based on direct observation, we recently derived a viable mechanism for assisted self-assembly of twisted layer graphene (Fig. 1). The process, which can be implemented in standard chemical vapor deposition (CVD) growth, is best described using the analogy to Origami and Kirigami of paper[4]. It involves controlled induction of wrinkle formation in single-layer graphene and subsequent wrinkle folding, tearing, and adlayer-growth. Inherent to the process is the formation of intertwined graphene spirals and conversion of the chiral angle of one-dimensional (1D) wrinkles into a 2D twist angle between layers in a three-dimensional (3D) superlattice. Seeded growth and substrate engineering can be used for tailored formation of layer stacks with pre-defined twist angles. The underlying principle is universal and can be extended to other foldable 2D materials and facilitates the production of miniaturized electronic components, including capacitors, resistors, inductors, and super-conductors.

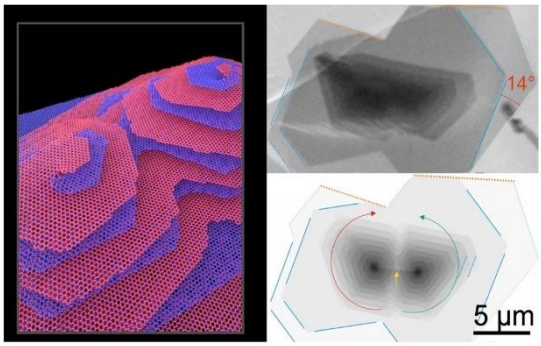

Fig.1.
Spirals of twisted layer graphene with pre-defined twist-angle. Comparison between s imulation and in-situ observation during CVD growth.

References

1 ZJ Wang et al. Adv. Mater. Interfaces 2018, 5, 1800255
[2] ZJ Wang et al., Nat Commun 7 (2016), p. 13256
[3] ZJ Wang et al. ACS Nano 2015, 9, 2, 1506–1519
[4] ZJ Wang et al., Nature Materials, Nat. Mater. (2023)

You are cordially invited to attend!