Fabrication of large-scale graphene/2D-germanium heterostructure by intercalation

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Heterostructures based on graphene and two-dimensional (2D) materials not only exhibit fascinating properties and potential applications, but also provide new horizons to the research of graphene. Our previous work show that we have successfully fabricated graphene/silicene van der Waals heterostructure, which exhibit Schottky rectification behavior. Here we report a large-scale, high-quality heterostructure composed of vertically-stacked graphene and two-dimensional (2D) germanium. The heterostructure is constructed by intercalation-assisted technique. We first synthesize large-scale, single-crystalline graphene on Ir(111) surface and then intercalate germanium at the interface of graphene and Ir(111). The intercalated germanium forms a well-defined 2D layer with a 2 × 2 superstructure with respect to Ir(111). Theoretical calculations demonstrate that the 2D germanium has a double-layer structure. Raman characterizations show the 2D germanium effectively weakens the interaction between graphene and Ir substrate, making graphene more like intrinsic one. Further experiments of low-energy electron diffraction, scanning tunneling microscopy, and X-ray photoelectron spectroscopy confirm the formation of large-scale and high-quality graphene/2D-germanium vertical heterostructure. The integration of graphene with a traditional 2D semiconductor provides a platform to explore new physical phenomena in the future.

References

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