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Construction and Functionality of Novel and Intrinsically Patterned 2D Materials

The novel properties of graphene-like honeycomb structure have spurred tremendous interest in investigating other two-dimensional (2D) layered structures beyond graphene. In this lecture, I will present construction of graphene, silicene, germanene, hafnium honeycomb lattice, monolayer PtSe2 as well as HfTe3/HfTe5, a superconductor-topological insulator layered heterostructure, on transition metal surfaces (TMS) (for example, Ru(0001), Pt(111), Hf(0001) and Ir(111)). Molecular beam epitaxial growth technique is used to form the large scale 2D atomic crystals on TMS. Low electron energy diffraction (LEED) and scanning tunneling microscopy/spectroscopy (STM/S) together with density functional theory (DFT) calculations are employed to confirm the formed structures on the TMS. In addition, we have successfully intercalated Si-layer at the interface between the formed graphene and the Ru(0001). The intercalation mechanism has been clarified with STM observations at an atomic level and the DFT calculations. Moreover, I will talk about 2D templates of $PtSe_2$ and CuSe recently developed for selective self-assembly of molecules nanoclusters, as well as for the functionalization of the same template with two different species. We expect that these new 2D crystals materials will show very interesting physical property and its promising potential applications in nanoscale devices.

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References

[1] Y. Pan et al., Adv. Mater. 21 (2009) 2777.
[2] L. Meng et al., Nano Lett. 13 (2013) 685.
[3] L.F. Li et al., Nano Lett. 13 (2013). 4671.
[4] L.F. Li et al., Adv. Mater. 26 (2014) 4820.
[5] Y.L. Wang et al., Nano Lett. 15 (2015) 4013.
[6] G. Li et al., J. Am. Chem. Soc. 137 (2015) 7099.
[7] Y.Q. Wang et al., Adv. Mater. 28 (2016) 5013.
[8] X. Lin et al., Nat. Mat. DOI: 10.1038/NMAT4915 (2017).