Interface processes confined under two-dimensional materials: from UHV to near ambient pressures

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In this talk I will first introduce our recent efforts to develop and construct a few state-of-art surface science techniques operating from ultrahigh vacuum to near-ambient pressure conditions. We used a deep ultraviolet (DUV) laser as the excitation source, developing high-resolution photoemission electron microscopy (DUV-PEEM@Dalian). Furthermore, by modifying the acceleration voltage system and introducing differential pumping system, PEEM imaging can be performed under near ambient pressure conditions (NAP-PEEM@Dalian, > 1.0 mbar). In addition, near ambient pressure X-ray photoelectron spectroscopy (NAP-XPS) and high-pressure scanning tunneling microscopy (HP-STM) systems have been installed in the labs, which enable to perform surface analysis close to ambient gas conditions and even in liquid environments. Second, with the in-situ surface techniques interface processes confined under two-dimensional (2D) materials such as graphene and h-BN have been investigated. We show that many elements and molecules can intercalate atomically thin 2D atomic crystals supported on solid surfaces and the space under the 2D overlayers can be regarded as nanocontainer. Chemical processes such as catalytic reactions, surface adlayer growth, and chemical vapor deposition also occur underneath such that the space under the 2D overlayers acts as nanoreactor. It has been demonstrated that surface chemistry and catalysis are strongly modulated by the 2D covers. Finally, we conclude that the confinement effect of the 2D cover leads to new chemistry in a small space such as concepts of “catalysis under cover” and “electrochemistry under cover”.

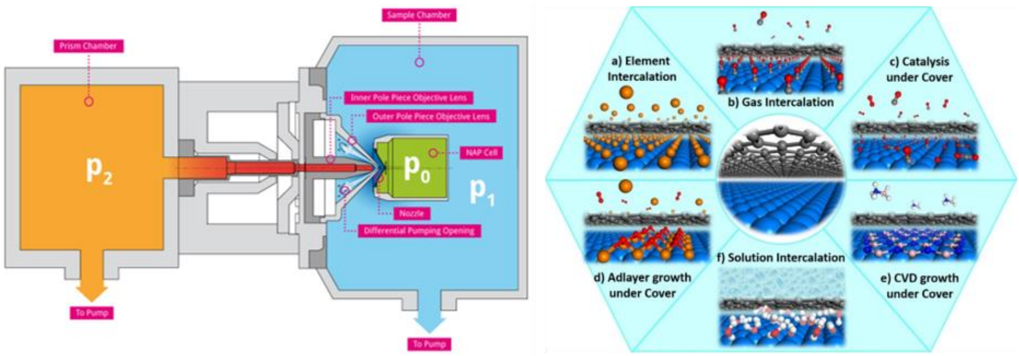

Figure 1. (left) scheme for differential pump systems in the NAP-PEEM@Dalian system; (right) chemical processes confined under 2D material overlayers.

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