Origin of Improved Optical Quality of Monolayer Molybdenum Disulphide Grown on Hexagonal Boron Nitride Substrate

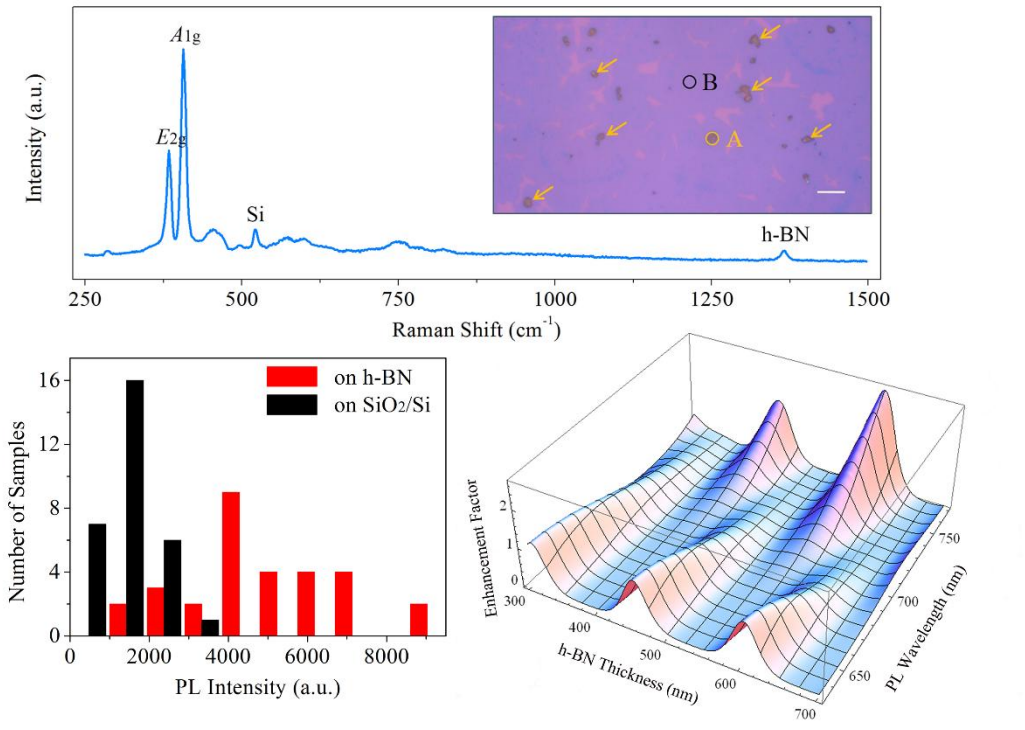
Lun Dai, Yi Wan, Hui Zhang, Wei Wang, Bowen Sheng, Kun Zhang, Yilun Wang, Qingjun Song , Nannan Mao, Yanping Li, Xinqiang Wang, Jin Zhang

State Key Lab for Mesoscopic Physics and School of Physics, Collaborative Innovation Center of Quantum Matter, Center for Nanochemistry, Beijing National Laboratory for Molecular Sciences, College of Chemistry and Molecular Engineering,Peking University,Beijing, 100871, P. R. China

Email: lundai@pku.edu.cn

We have devised and realized a high-yield and convenient method to synthesize monolayer MoS_2 directly on h-BN flakes via the chemical vapor deposition (CVD) method. Compared with that grown on SiO_2/Si substrate, the monolayer MoS_2 grown on h-BN exhibits enhanced photoluminescence (PL) and Raman signals as well as the smaller intensity ratio of E_{2g} to A_{1g}. Besides, its A_{1g} Raman mode exhibits clear stiffening, whereas its E_{2g} mode exhibits a negligible shift. We have calculated the PL intensity as function of both the h-BN thickness and the PL wavelength, based on light ray propagation in multilayer structure. Combining the theoretical and experimental analysis, we draw the conclusion that the enhanced PL and Raman signals of monolayer MoS_2 originates probably from the relatively weak doping effect from the h-BN substrate, rather than the optical interference effect suggested previously. Using h-BN as substrate may provide a possibility of investigating the intrinsic property of mono layer MoS_2, such as the novel valley-spin related property.

Figures



References

[1] Yi Wan, Hui Zhang, Wei Wang, Bowen Sheng, Kun Zhang, Yilun Wang, Qingjun Song, Nannan Mao, Yanping Li, Xinqiang Wang, Jin Zhang, and Lun Dai*, Small **12** , (2016) 198.