复旦大学物理系物质科学报告

Physics Department Colloquium

Spin-Valley Polarizations in 2D Transition Metal Dichalcogenide Monolayers and Heterostructures

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A robust valley polarization is a key prerequisite for exploiting valley pseudospin to carry information in next-generation electronics and optoelectronics. Monolayer transition metal dichalcogenides (TMDs) with inherent spin-valley coupling offer a unique platform to develop such valleytronic devices. However, realization of robust valley polarization at room temperature remains challenging. In this talk, I will demonstrate the generation of long-lived valley-polarized holes in monolayer WSe_2 and $WSe_2/MoSe_2$ heterostructures by optical pumping. Using time-resolved Kerr rotation spectroscopy, we observe a very long-lived valley polarization (~ 1ns) in monolayer WSe_2 at low temperatures, which is much longer than the trion recombination lifetime ($\sim 10-20$ps). The long-lived valley polarization can be attributed to the transfer of valley pseudospin from photocarriers to resident holes in a specific valley. The optically initialized valley holes remain robust even at room temperature, which opens up the possibility to realize room-temperature valleytronics based on TMDs. In $WSe_2/MoSe_2$ heterostructures, the interlayer carrier transfer and the formation of interlayer exciton further stabilize the valley polarizations. In particular, we found that the interlayer charge transfer is spin dependent, while the momentum conservation is relaxed by the large energy mismatch. We show that the stacking symmetry play a critical role in the interlayer spin transfer.

Reference

[1] W.-T. Hsu, Y.-L. Chen, C.-H. Chen, P.-S. Liu, T.-H. Hou, L.-J. Li, and W.-H. Chang, Nature Comm. 6, 8963 (2015).

[2] M.-Y. Li, Y. Shi, C.-C. Cheng, L.-S. Lu, Y.-C. Lin, H.-L. Tang, M.-L. Tsai, C.-W. Chu, K.-H. Wei, J.-H. He, W.-H. Chang, K. Suenaga, and L.-J. Li, Science 349, 524 (2015).

[3] M.-H. Chiu, M.-Y. Li, W. Zhang, W.-T. Hsu, W.-H. Chang, M. Terrones, H. Terrones, and L.-J. Li, ACS Nano 8, 9649 (2014).

[4] W.-T. Hsu, Z.-A. Zhao, L.-J. Li, C.-H. Chen, M.-H. Chiu, P.-S. Chang, Y.-C. Chou, and W.-H. Chang, ACS Nano 8, 2951 (2014).

Time： 2:00pm, Tuesday, December 13, 2016

Location： Physics Building, Room 221B

(Cookies and coffee are served from 1:30 pm)