DIRECT DETERMINATION OF BAND GAP RENORMALIZATION IN PHOTO-EXCITED MONOLAYER MOS_2

FANG LIU, MARK E ZIFFER, KAMERON R HANSEN, JUE WANG, XIAOYANG ZHU[a], *Chemistry, Columbia University, New York, NY, USA*.

A key feature of monolayer semiconductors, such as transition-metal dichalcogenides, is the poorly screened Coulomb potential, which leads to large exciton binding energy (E_b) and strong renormalization of the quasiparticle bandgap (E_g) by carriers. The latter has been difficult to determine due to cancellation in changes of E_b and E_g, resulting in little change in optical transition energy at different carrier densities. Here we quantify bandgap renormalization in macroscopic single crystal MoS_2 monolayers on SiO_2 using time and angle resolved photoemission spectroscopy (TR-ARPES) with femtosecond extreme UV (EUV) probe. At excitation density above the Mott threshold, E_g decreases by as much as 360 meV. We compare the carrier density dependent E_g with previous theoretical calculations and show the necessity of knowing both doping and excitation densities in quantifying the bandgap.

[a]To whom correspondence should be addressed. E-mail: xyzhu@columbia.edu