ROOM-TEMPERATURE VALLEY POLARIZATION OF EXCITONIC EMISSION IN TRANSITION METAL DICHALCOGENIDE MONOLAYERS

Sergii Morozov[1], Torgom Yezekyan[1,2], Christian Wolff [1],

Sergey I. Bozhevolnyi[2,3], N. Asger Mortensen[1,3]

[1]POLIMA—Center for Polariton-driven Light–Matter Interactions, University of Southern Denmark, Campusvej 55, DK-5230 Odense M, Denmark, [2]Center for Nano Optics, University of Southern Denmark, Campusvej 55, DK-5230 Odense M, Denmark, [3]Danish Institute for Advanced Study, University of Southern Denmark, Campusvej 55, DK-5230 Odense M, Denmark.

e-mail: semo@mci.sdu.dk

Our study demonstrates the charge-induced build-up of strong valley polarization in transition metal dichalcogenide (TMD) monolayers at room temperature. We achieve valley polarization contrasts of 61% in tungsten diselenide (WSe_2) and 37% in molybdenum diselenide ($MoSe_2$), paving the way for practical valleytronic devices at ambient conditions.

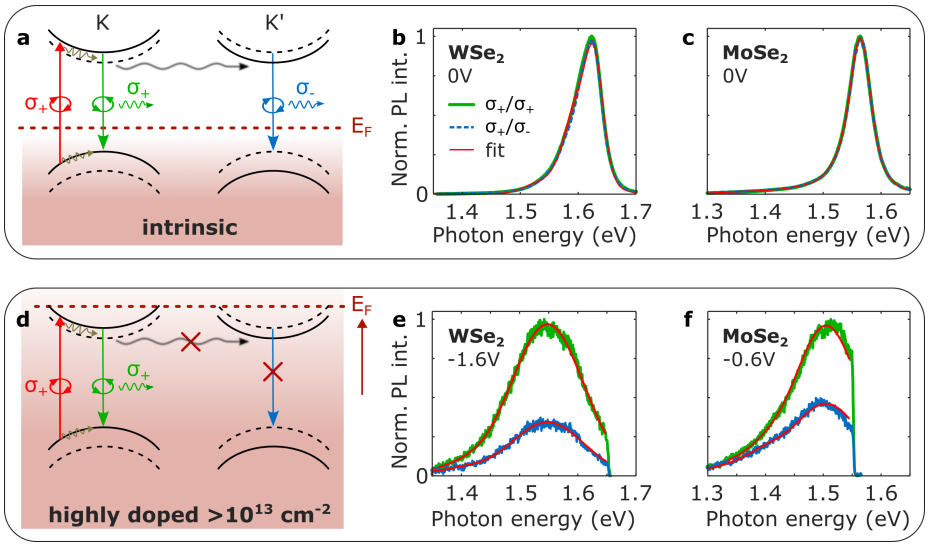

Fig.1 (a) Schematic band structure of a TMD monolayer around K and K' points of the Brillouin zone at neutral bias. (b-c) Spectral and polarization response of TMD monolayers to the neutral voltage corresponding to the charge neutrality point. (d) In the case of strong electron doping, the intervalley scattering processes are suppressed. (e-f) Polarization-resolved spectra acquired at the strong electron doping regime demonstrate high valley polarization contrast even at room temperature.

We investigate the underlying mechanisms governing the optical excitation and relaxation processes that impact the valley polarization dynamics in TMD monolayers [1]. By analysing the response of the monolayers to strong electron doping [2], our study provides crucial insights into the interplay between doping levels and the resulting valley polarization dynamics (Fig.1). Through the control of the Fermi energy level, we showcase the transition to high valley polarization.

References

1. S. Morozov *et al.*, *npj 2D Mater Appl* 8, 24 (2024).
2. S. Morozov *et al.*, *Adv. Opt. Mater.*, vol. 9, no. 22, p. 2101305 (2021).