Room Temperature Valley Polarization and Coherence in Transition Metal Dichalcogenide-Graphene van der Waals Heterostructures

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Van der Waals heterostructures made of graphene and transition metal dichalcogenides (TMD) are an emerging platform for opto-electronic, -spintronic and -valleytronic devices that could benefit from (i) strong light-matter interactions and spin-valley locking in TMDs and (ii) exceptional electron and spin transport in graphene. The operation of such devices requires significant valley polarization and valley coherence, ideally up to room temperature. Here, using a comprehensive Mueller polarimetry analysis, we report *artifact-free* room temperature degrees of valley polarization up to $40~\%$ and, remarkably, of valley coherence up to $20~\%$ in monolayer tungsten disulfide (WS_2)/graphene heterostructures. Valley contrasts have been particularly elusive in molybdenum diselenide ($MoSe_2$), even at cryogenic temperatures. Upon interfacing monolayer $MoSe_2$ with graphene, the room temperature degrees of valley polarization and coherence are as high as $14~\%$ and $20~\%$, respectively. Our results are discussed in light of recent reports of highly efficient interlayer coupling and exciton transfer in TMD/graphene heterostructures and hold promise for room temperature chiral light-matter interactions and coherent opto-valleytronic devices.

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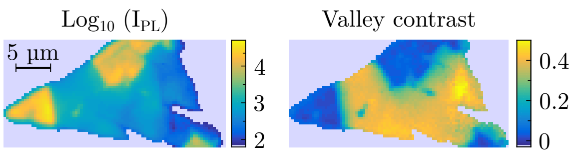

Figure 1: (a) Photoluminescence intensity Map and (b) degree of valley polarization of a Boron nitride (BN)-capped WS_2/Graphene heterostructure optically excited at 633 nm (1.96 eV)