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The Orientation of Luminescent Excitons in Layered Organic Nanomaterials JON SCHULLER, Columbia University, SINAN KARAVELLI, Brown University, KELIANG HE, Case Western Reserve University, SHYUAN YANG, columbia university, JIE SHAN, Case Western Reserve University, JOHN KYMISSIS, Columbia University, RASHID ZIA, Brown University — A fundamental understanding of optoelectronics in organic semiconductors is complicated by the diversity of excitons which can exist within a single material system. Measurements that distinguish between different exciton types are crucial for a complete understanding of organic materials. By fitting experimental curves of angle-, polarization-, and energy-dependent PL to analytical Purcell calculations we quantify the relative dipole moments for in-plane and out-of-plane oriented excitons in organic and inorganic layered nanomaterials. In mono- and bi-layers of Molybdenum Disulfide (MoS2) and Graphene Oxide the luminescence arises only from in-plane oriented excitons. In the perylene derivative PTCDA, however, we show that PL arises from both in-plane and out-of-plane excitons. We observe a difference in emission frequency between the dipole orientations which indicates the existence of two distinct exciton species: an in-plane oriented Frenkel exciton and an out-of-plane oriented Charge Transfer exciton. Based on these results we devise and implement a method for isolating luminescence from either exciton species. We observe different temporal dynamics for the two distinct excitons, highlighting the power of this technique for fundamental studies of organic materials.

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