

2D perovskite heterostructures are in the forefront of current research for photodetector (PD) application because of their outstanding optoelectronic performances and synergies of the conjugated semiconductor band alignments. Their magnificent optical and electronic properties fulfil the criteria for the potential photodetector candidate. In the present day, perovskite materials are very promising in terms of their easy and low-cost preparation method, outstanding visible absorption and emission and their efficient solar to power conversion efficiencies. Tremendous achievements in 2D semiconductor heterojunctions have been obtained in photodetector applications. Perovskite semiconductors forms atomic thin-layer to thicker nanoplatelets to micron-sized 2D sheets, which are considered to be effective as an active layer for the PD application. In this context, several concepts are employed in this proposal to explore the opportunities of perovskite heterostructure-based PDs.

Heterojunction in semiconductors define a conjugation of two different material with dissimilar bandgaps, which combines through lattice matching between their crystals. Experimental synthesis experiences some difficulties of lattice matching between two individual semiconductors, which indeed restricts potential band conjugation and hence fails to provide esteemed synergies. In this point, 2D materials are very interesting for the formation of van der Waals heterojunction between two different semiconductor nanosheets provided their hybrid organic-inorganic structure, surface charges in the lateral direction of the nanoplatelets, etc. Interestingly, 2D perovskites contribute thickness dependent bandgap tuning, where with the increase of thickness of the platelets, bandgap decreases. Therefore, coexistence of 2D hybrid organic-inorganic perovskites with different thickness in solution or thin film form van der Waals heterostructures. This phenomenon is quite interesting to explore the heterostructure-based PD applications. Apart from this, treatment of 2D perovskite nanoplatelets and transition metal dichalcogenides (TMDC) is liable to form van der Waals heterostructure, which has proven to provide some enhanced performances. Inspired from this concept, this project will be on the discovery of new heterojunction with different thickness of perovskites and TMDC semiconductors altering their thickness to optimize the best PD performance.