

# Optoelectronic properties of 2D Ruddlesden-Popper halide perovskite semiconductors

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In the past five years, solution-processed organometallic perovskite based solar cells have emerged as a promising thin-film photovoltaic technology. Presently, the intended optoelectronic applications of this class of materials are in the realm of conventional semiconductors. The spin-orbit coupling is giant and shows up in the conduction band,<sup>1</sup> the band gap is direct with the critical wavevector located at one of the edges of the reference Brillouin zone, and among others, excitonic or Rashba-Dresselhaus effects play a crucial role.<sup>2</sup> Then, the electronic band structure can be modeled using either Density Functional Theory calculations or empirical methods such as the tight-binding model and the multiband **k.p** method, provided that accurate descriptions of symmetry properties are proposed.<sup>2</sup> Layered 2D Ruddlesden-Popper phases, composed of perovskites layers sandwiched between two layers of large organic cations, have recently demonstrated improved photostability under standard illumination as well as humidity resistance over 2000 hours, affording a conversion efficiency of 12.5 %.<sup>3</sup> In this case, intrinsic quantum<sup>4</sup> and dielectric carrier confinements<sup>5</sup> are afforded by the organic inner barriers, which leads to a stable Wannier exciton at room temperature. However, device efficiencies are essentially related to extremely efficient internal exciton dissociation through edge states in layered 2D Ruddlesden-Popper perovskites, as shown from the investigation of both thin films and small single crystals.<sup>6</sup>

## References

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<sup>6</sup> J. C. Blancon et al, Science 2017