Reducing Carriers Effective Mass wit Benzotriazole Organic Spacers in 2D Perovskites

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Two-dimensional (2D) perovskites are under constant investigation by the scientific community owing to the broad scope of technologically relevant applications. These soft, ionic, crystals with layered structures consist of octahedral slabs separated by large organic spacers. Importantly, the choice of the organic spacer should not influence the band structure but have a considerable impact on the optical properties, which has been traced back to the distortion of the inorganic sublattice imposed by the organic spacers. For instance, it was shown that the in-plane and out-of-plane distortion of the octahedral part significantly changes the emission and absorption energy, leading to the exciton self-trapping and modification of the reduced effective mass of charge carriers. The latter one is of paramount importance as the reduced effective mass directly controls such important physical parameters as carrier mobility, exciton binding energy, and diffusion length.

Just recently the effective mass of the prototypical 2D perovskite $(PEA)_2PbI_4$ has been directly measured by high magnetic field spectroscopy by observing interband Landau level transitions. [1] A natural question arises, to what extent the reduced effective mass can be tuned in 2D perovskites?

We investigate a novel class of benzotriazole-based lead (II) iodide 2D perovskites- $(BTa)_2PbI_4$ and $(F_2BTa)_2PbI_4$, that are characterized by an exceptionally low degree of octahedral tilting. [2] For such an undistorted system, we performed magneto-spectroscopy under high-magnetic field up to 90T. Both the diamagnetic coefficient of the 1s exciton state and the interband Landau levels transitions provide insight that the reduced effective mass in this undistorted system is further reduced when compared to the well-studied compounds.

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[2] A. Caiazzo, A. Maufort, B. T. van Gorkom, W. H. M. Remmerswaal, J. F. Orri, J. Li, J. Wang, W. T. M. van Gompel, K. Van Hecke, G. Kusch, R. A. Oliver, C. Ducati, L. Lutsen, M. M. Wienk, S. D. Stranks, D. Vanderzande, R. A. J. Janssen, *ACS Appl. Energy Mater.*, **6**, 7 (2023).