Using large scale scattering facilities to study structural and optoelectronic properties of 2D and 3D perovskites

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The presentation will describe a few recent results on the structural and optoelectronic properties in 2D and 3D halide perovskites, focusing on some possibilities offered by nowadays neutron, X-rays and electron large scale scattering facilities. Phonon spectroscopy with q-space resolution based on neutron scattering triple axis spectrometers, combined with additional Brillouin and Raman scattering [1], as well as phonon photoluminescence side bands measured in perovskite quantum dots [2], are necessary to obtain a more realistic picture of the strongly anharmonic vibrational density of states of 3D perovskites. This will allow in the near future to go beyond state of the art simulations of intrinsic carrier mobilities in 3D perovskites [3], as well as to address carrier relaxation in the electronic band structure. For that purpose, ultrafast electron diffraction (UED) is another little explored, yet powerful technique, to gain insight into fundamental processes governing hot carrier relaxation in 3D perovskites [4]. Unexpected carrier relaxation mechanisms revealed recently in 2D perovskites by UED will be presented [5]. Finally, the high brightness of synchrotron facilities that was initially needed to track the flipping of 2D perovskite layers in inverted solar cells [6], further allows monitoring the 2D perovskite growth, with nano-seeds in the precursor solutions of 2D perovskites [7], or with interface engineering of hole transport layer [8], as well as light induced structural changes in operating 2D perovskite devices [9]. These last changes are correlated with a percolation behavior of the carrier mobility, leading in turn to sudden modifications in the electrical characteristics, which are different from previously observed gradual changes for 3D perovskites [10].

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