

# Spin-dependent light scattering in CsPbBr<sub>3</sub> perovskite crystal

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Spin-dependent properties of cesium lead halide perovskite CsPbBr<sub>3</sub> semiconductor are investigated by means of spin-flip Raman scattering (SFERS) spectroscopy. The SFERS technique allows one to measure directly the Zeeman splitting of the electron, hole and exciton from the spectral shift of the scattered light from the laser photon energy. Therefore, the g-factors of electron, hole and exciton can be determined, as well as their anisotropies. Experiments are performed in magnetic field up to 10 Tesla at cryogenic temperatures.

In the SFERS spectrum measured under resonant excitation in the vicinity of the exciton resonances at ~2.33 eV in magnetic field pronounced lines associated with the electron and hole spin-flips are detected (Fig. 1).

The X<sub>2</sub> line is assigned to the exciton spin-flip between the states with  $|\pm 1\rangle$  spins. Exciton g-factor measured via Raman shift of X<sub>2</sub> line is the sum of g-factors of electron and hole. The g-factor of the X<sub>1</sub> line has about twice smaller g-factor compared to the X<sub>2</sub> line. This allows us to attribute this line with the exciton spin-flip transitions  $|+1\rangle \rightarrow |0\rangle$  and  $|0\rangle \rightarrow |-1\rangle$ . Angular dependences show that hole and electron have anisotropic g-factors [1] while exciton g-factor is almost isotropic [2].

We show that the spin-dependent light scattering is a sensitive optical tool for local strains and long-range ordering, which can be modified by laser annealing. For instance, line attributed to the exciton fine structure (X<sub>1</sub>) shifts with applying strain to the CsPbBr<sub>3</sub> crystal. Brillouin light scattering spectra in CsPbBr<sub>3</sub> perovskite show lines attributed to exciton-polaritons. They shift in energy and become polarization sensitive in magnetic field evidencing the spin splitting of the polariton dispersion in this case. These lines are well-distinguished in the crystalline phase and suppressed in the amorphous phase.

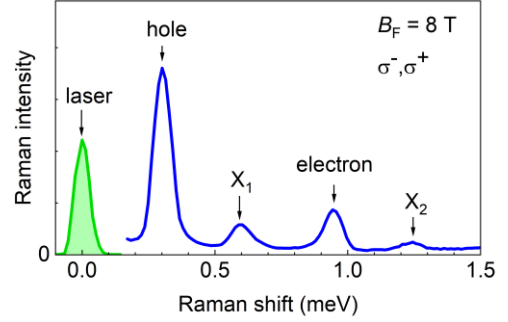


Figure 1. SFERS spectrum of CsPbBr<sub>3</sub> crystal measured in cross-circular polarizations at  $B_F = 8$  T applied in Faraday geometry.

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[2] N. E. Kopteva, D. R. Yakovlev, E. Kirstein, E. A. Zhukov, D. Kudlacik, I. V. Kalitukha, V. F. Sapega, O. Hordiichuk, D. N. Dirin, M. V. Kovalenko, A. Baumann, J. Höcker, V. Dyakonov, S. A. Crooker and M. Bayer, *Small* **23**00935 (2023).