Multiple Photon Excitation Processes in $CsPbBr_3$ Nanocubes

Aurora Manzi,[a,b] Yu Tong,[a,b] Alexander S. Urban,[a,b] Lakshminarayana Polavarapu,[a,b] Jochen Feldmann[a,b]

[a]Chair for Phoronics and Optoelectronics, Ludwig-Maximilians-Universität, Munich, Germany
[b]Nanosystems Initiative Munich (NIM), Munich, Germany

Below band-gap photons normally pass the respective semiconductor and cannot be used for optical or optoelectronic functions such as solar energy conversion processes. Multiple photon excitation processes, however, represent a route to access such low-energy photons leading to the generation of electrons and holes in the conduction- and valence-band, respectively. In this way below band-gap photons can create either photoluminescence or even photocurrent.

In recent years, metal halide perovskites have shown their high potential for photovoltaic as well as for light-emitting applications. In these studies, we have investigated the interband photoluminescence of $CsPbBr_3$ nanocubes [1] for optical excitation below the band-gap occuring at about 2.38 eV. We find that the exponential dependence of the experimentally observed multiple-step absorption process changes with the laser excitation wavelength (see Fig.1). In addition, the photoluminescence excitation spectrum shows resonances at specific wavelengths. These resonances can be understood by comparing the multiple-step absorption processes with respective relaxation scenarios of the photoexcited electron-hole pairs.

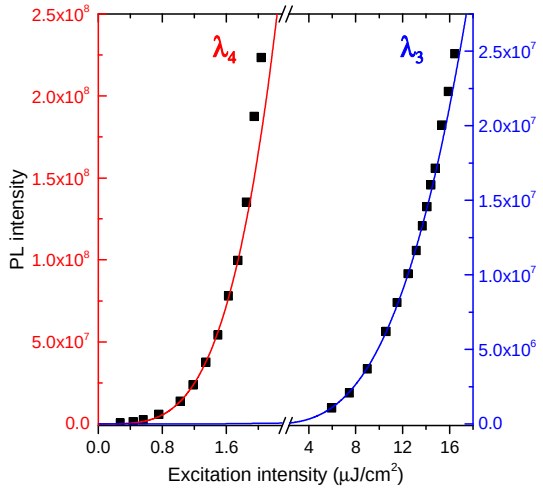

Fig. 1 Photoluminescence intensity as a function of laser excitation intensity for two below band-gap excitation wavelengths.

1) Y. Tong, E. Bladt, M. Ayguler, A. Manzi, K. Z. Milowska, V. A. Hintermayr, P. Docampo, S. Bals, A. S. Urban, L. Polavarapu, J. Feldmann, Angewandte Chemie 44, 13887 (2016)