Prof. Gerd Bacher
Universität Duisburg-Essen

Advanced Optical Spectroscopy on Colloidal Nanocrystals

Date: May 17 2021, 15.00 h Hamburg time

Abstract

Remarkable progress in chemical synthesis enables the design of nanocrystals with defined composition and targeted architecture, which can be further functionalized by doping. Two of the most prominent material classes are II-VI compounds, where size and shape engineering as well as doping has been developed to a high degree of perfection, and lead halide perovskites, which emerged only recently. Naturally, a variety of application scenarios, e.g., in optoelectronics, information technology or energy science, have been suggested.

In this talk I will demonstrate the potential of sophisticated optical spectroscopy - down to the level of *single* nanocrystals - to unravel some surprises in these exciting nanomaterials. Experiments on single lead halide perovskite quantum dots and nanoplatelets give dedicated insights into crystal phases, phonon coupling and exciton fine structure [1]. Single nanocrystal spectroscopy on doped II-VI quantum dots reveals novel spin phenomena: Directed laser-induced magnetization is achieved [2], and the spin state of an individual dopant can be probed [3]. Reducing the size down to magic-sized nanocluster consisting of only 26 atoms enables a digital change of bandgap [4] and magnetic functionality [5]. The small number of atoms leads to a weakening of the chemical bonds under laser excitation und thus to an unexpected strong shift of the bandgap with temperature [6].

[1] O. Pfingsten et al., Nano Letters 18, 4440 (2018)
[2] S. Lorenz et al., Nano Letters 20, 1986 (2020)
[3] R. Fainblat et al., Nano Letters 16, 6371 (2016)
[4] J. Yang et al., JACS 139, 6761 (2017)
[5] F. Muckel et al., ACS Nano 10, 7135 (2016)
[6] F. Muckel et al., Nature Comm. 11, 4127 (2020)