Aktuelle Fragen
der Nanophysik

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Phonon coupling in hexagonal boron nitride defect centers

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Many promising quantum applications require reliable single-photon emitters. Especially in the context of solid state quantum light sources many systems have obvious advantages but most often also suffer from disadvantages. Semiconductor quantum dots, on the one hand, represent a mature technology platform, but presently yield optimum performance only at cryogenic temperatures. Color centers in diamond, on the other hand, show single photon emission at room temperature but suffer from a high refractive index and challenging processability of the host matrix.
Defect centers in hexagonal boron nitride (hBN) stand out as solid state single photon sources by combining room temperature performance and the mechanical flexibility and robustness of layered van der Waals materials (like TMDCs). Especially the latter aspect makes these materials easy to process and opens many possibilities for implementation.
I will present a combined experimental and theoretical study of the phonon influence on the photon emission and absorption properties of the defect centers in hBN. The wide range of transition energies from 1.7~eV to 2.5~eV of these quantum light emitters makes the identification of the underlying atomic structure still challenging. Besides their light emission properties, they have a remarkable coupling to phonons. In photoluminescence spectra longitudinal optical (LO) phonons lead to strong sideband emission well separated from the zero phonon line (ZPL). Additionally, the ZPL itself is asymmetrically broadened which we attribute to the coupling to local oscillation modes of the defect against the entire crystal. By performing photoluminescence excitation (PLE) measurements we study the role of phonons for the photon absorption properties of the defect centers. We developed a promising strategy to select a desired ZPL energy from the wide spread of emission energies by exciting the emitter via a LO phonon-assisted photon absorption.