

Two-dimensional inorganic-organic hybrid perovskites under pressure

Paul Steeger¹, Mohammad Adnan¹, Thorsten Deilmann², Xiang Li³, Susanne Müller⁴, Katarzyna Skrzyńska⁵, Michael Hanfland⁴, Efim Kolesnikov³, Jutta Kösters⁶, Theresa Block⁶, Robert Schmidt¹, Ilya Kупenko³, Carmen Sanchez-Valle³, G. Vijaya Prakash⁷, Steffen Michaelis de Vasconcellos¹, Rudolf Bratschitsch¹

¹Institute of Physics and Center for Nanotechnology, University of Münster, Münster, Germany. ^{2b}Institute of Solid State Theory, University of Münster, Münster, Germany.

³Institute of Mineralogy, University of Münster, Münster, Germany. ⁴European Synchrotron Radiation Facility, Grenoble, France. ⁵Institute of Earth Sciences, University of Silesia, Sosnowiec, Poland. ⁶Insitut für Anorganische und Analytische Chemie, University of Münster, Münster, Germany. ⁷Department of Physics, Indian Institute of Technology Delhi, New Delhi, India

Abstract

Two-dimensional inorganic-organic hybrid perovskites are promising for optoelectronic applications. One representative of this class of materials is cyclohexenyl-eythylammonium lead-iodide (CHPI). Here, we present pressure-dependent optical absorption and emission spectra of CHPI. We find a strong change of the band gap when exerting pressure on the crystal using a diamond anvil cell. In contrast to other 2D perovskites, the bandgap of CHPI undergoes a full hysteresis loop under pressure. To reveal its origin, we combine our optical experiments with DFT calculations as well as X-ray diffraction measurements under high pressure.