nano X invited scientist

Position Assistant Professor

Affiliation Wroclaw University of Science and Technology

Host lab at NanoX LNCMI Team Quantum Electronics

NanoX contact Paulina Plochocka

Dates of stay

Brief Biodata

During his PhD at EPFL, Alessandro Surrente focused on the epitaxial growth and spectroscopy of site-controlled quantum dots (QDs) on non-planar substrates. During his first postdoc, at LPN, CNRS, he characterized the optomechanical response of an optomechanical resonator consisting of a suspended InP membrane, heterogeneously integrated on a Si substrate. During his second postdoc, at LNCMI, CNRS, he has worked on the magneto optical properties of emerging semiconductors, such as transition metal dichalcogenides (TMDs) and metal halide perovskites. After a Marie Curie Individual Fellowship at Sapienza University of Rome, he joined as Assistant Professor the Department of Experimental Physics of the Wroclaw University of Science and Technology, where he investigates the electronic and optical properties ofperovskite colloidal nanocrystal and nanoplatelets.

Research project during the visit at nanoX

Metal halide perovskites, one of the most intensively investigated materials for photovoltaics, have a composition described by the formula ABX_3. The A site is occupied by an organic ammonium cation as methylammonium, MA, formamidinium, FA, or Cesium, Cs. The B site is occupied by Pb or Sn and X represents a halide anion, which together form the inorganic octahedral cage of the crystal. Even though perovskites have favourable properties for application in optoelectronics, they show however a low quantum yield of the photoluminescence (PL). A solution this problem has been found with the synthesis of perovskite-based nanocrystals. Our interested is currently devoted to the properties of nanoplatelets, colloidal quantum wells with a very well controlled thickness of the well layer.

A number of open questions concerning the fundamental properties of perovskite nanoplatelets are currently unanswered. We will initially study how the exciton binding energy and the reduced mass depend on the thickness of the inorganic cage. We will then shift our focus to the investigation of the fine structure of the exciton manifold as a function of the thickness of the nanoplatelets. The strong dielectric and quantum confinement in perovskite nanoplatelets is expected to influence the electron-hole exchange interaction, which determines the fine structure of the exciton manifold. Thus, we expect that by changing the thickness, we can vary the details of the exciton fine structure. We will study how the dark-bright level and the fine structure splitting of the bright exciton are influenced by the large quantum and dielectric confinement. These questions will be investigated with a series of absorption measurements in pulsed magnetic field, both in Faraday and in Voigt configuration, performed on $CsPbBr_3$-based nanoplatelets of different thickness.