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CV/ biography

Laura Piveteau completed her bachelor and master studies in chemistry at ETH Zurich (Switzerland) and earned her doctoral degree at the same institution in the group of Maksym V. Kovalenko. Her doctoral studies were supported by the Fund of the Swiss Chemical Industry (SSCI) with a Scholarship. She was awarded the ETH medal for her doctoral thesis and her research revolved around developing, adapting and applying nuclear magnetic resonance (NMR) spectroscopy to colloidal semiconductor nanocrystals, with the goal to shine light on the surface and overall structure of these materials. She is currently a postdoc in the CEMHTI lab at CNRS Orléans, where she is developing NMR techniques to visualize structures and order in the intermediate range under the supervision of Dominique Massiot.

Colloidal Semiconductor Nanocrystals as Seen by Solid-State NMR spectroscopy

Colloidal semiconductor nanocrystals (NCs) are a highly versatile and precisely controllable class of materials with exceptional optoelectronic properties, which renders them very attractive for numerous applications. Although being intensely investigated, the interplay between their structure, in particular their surface structure, and their outstanding properties remains largely elusive. Major challenges are the reduction or lack of translational order of the atomic structure and the high degree of disorder in colloidal semiconductor NC materials, which impede the working horse for structural elucidation, which is X-ray diffraction, to provide the desired insights.

Nuclear magnetic resonance (NMR) is a powerful non-invasive analytical method to characterize not only small molecules in the solution-state but also large molecules, colloids, crystals and amorphous materials in the solid-state. Solid-state NMR spectroscopy accesses isotope-specifically the local chemical and electronic structure and does not pose any requirements to the crystallinity of samples. Hence, it can provide insight into the chemical composition, distribution and topology of materials by visualizing connectivity among nuclear spins as well as their structural geometry and molecular dynamics.

In this presentation, various approaches shall be discussed to illustrate the great versatility and power of NMR spectroscopy to characterize colloidal semiconductor NCs. In particular, sensitivity and resolution enhancing techniques, such as dynamic nuclear polarization (DNP) and side-band separating methods, have proven highly valuable to distinguish surface and NC core signals. This contributes to the identification of chemical species present in and around NCs, such that their evolution can be traced during reactions (*e.g.* shell growth by colloidal atomic layer deposition). Solid-state NMR and the closely related nuclear quadrupole resonance (NQR) can also serve as sensitive probes of local and temporal structure fluctuations, as will be discussed on the case of lead-halide perovskite materials.

Keywords: solid-state NMR, semiconductor nanocrystal, DNP, NQR, perovskites