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#ICMolTalks

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Abstract

Lanthanide-Based Nanoparticles – From Synthesis to Sensors

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The optical properties of lanthanide (Ln) ions make Ln-based materials attractive for applications ranging from biomedicine to optomagnetic, optoelectronic, and energy conversion technologies. Their unique electronic structure enables upconversion, i.e., the emission of UV-visible light under near-infrared (NIR) excitation. In addition, some Ln-based materials emit in the NIR under NIR excitation, operating entirely within the so-called NIR transparency window, which is particularly attractive for biomedical applications.

Sodium lanthanide fluorides ($NaLnF_4$) are a well-established host material, and we have developed a microwave-assisted synthesis that enables control over crystal phase and particle size below 20 nm. With this fast and reliable synthetic route, we now explore different nanoparticle architectures and compositions to optimize optical and magnetic properties, with the aim of developing brighter emitters, biocompatible multimodal imaging probes, and nanoscale thermal sensors. In parallel, alternative host materials for upconverting Ln3+ dopants are being investigated, including new synthetic routes to lanthanide fluorides, oxyfluorides, and oxysulfides.

This presentation provides an overview of Ln-based materials with a focus on microwave-assisted synthesis and nanoparticle design for imaging and thermal sensing applications. In the context of thermal sensing, recent results on the cross-sensitivity of luminescence intensity ratios will be discussed, highlighting potential limitations and suggesting more reliable alternative strategies.

Biography

Dr. Eva Hemmer is an Associate Professor and holds a University Research Chair in Materials Chemistry at the University of Ottawa, Canada. She received her PhD (2008) in materials science from Saarland University (Germany) under the mentorship of Prof. Mathur. During her PhD she focused on the synthesis of lanthanide-containing inorganic nanomaterials, followed by postdoctoral studies on lanthanide-doped nanoparticles for near-infrared bioimaging with Prof. Soga (Tokyo University of Science, Japan, 2009-2012). In 2013, she was awarded a Feodor Lynen Research Postdoctoral Fellowship (Alexander von Humboldt Foundation; groups of Profs. Vetrone and Légaré, INRS-EMT, Canada, 2012-2015) to develop nanothermometers based on upconverting nanoparticles. Since 2016 she is at the Department of Chemistry and Biomolecular Sciences at uOttawa focusing on the synthesis and photophysical properties of multifunctional lanthanide-based nanocarriers.

She received the 2021 Jubilee Global Diversity Award of the ACerS (American Ceramic Society; Engineering Ceramics Division), the 2021 Early-career Achievement Award in Nanoscience and Nanotechnology by NanoOntario as well as the 2024 Early Career Researcher of the Year of the University of Ottawa.

Since February 2024, Eva serves as associated editor for Nanoscale and Nanoscale Advances.

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