

## **Luminescence Nanothermometry with Lanthanides: Principles, Applications and Challenges**

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This is the first webinar in a series, organized by NanoTBTech – a consortium of European research groups joining expertise in the development of superior thermal imaging systems. It is the aim of this webinar to provide an insightful introduction to the field of luminescence nanothermometry for people starting in the field while also providing deeper understanding for more experienced nanothermometry researchers.

Luminescence nanothermometry is an exciting field of research that is opening new avenues for accurate remote temperature sensing and mapping of temperature profiles with high spatial resolution. A promising class of nanomaterials relies on luminescence of lanthanide ions. First an introduction is given to the unique features of lanthanide luminescence to provide or reinforce understanding of the basic optical properties of lanthanides that enable nanothermometry. Next, the use of lanthanide luminescence for remote temperature sensing is explained and illustrated for temperature sensing relying on Boltzmann equilibrium. Pitfalls are also identified. A few carefully chosen applications are discussed in detail, aimed at giving a thorough understanding of how lanthanide-based nanothermometry works and offers advantages over other temperature sensing methods. Specifically, applications in the field of temperature sensing in biological systems (temperature range 300-350 K), recent applications of high temperature sensing (> 400 K) and the ability to realize temperature mapping with spatial resolution in the  $\mu\text{m}$  range are discussed. Finally, challenges and an outlook are presented to stimulate further research in the field.