COLOUR-TUNEABLE LANTHANIDE-BASED NANOPARTICLES FOR APPLICATIONS FROM BIOMEDICINE TO PRINTING

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ABSTRACT:

Based on their outstanding optical properties, lanthanide-based compounds have been suggested for a wide range of applications including the fields of biomedicine, optoelectronics, and solar energy conversion. For instance, the capability of lanthanide-based materials to emit visible and near-infrared (NIR) light under NIR excitation is highly sought after when aiming for biomedical applications. This is as NIR light penetrates deeper into biological tissue and is less phototoxic than UV light commonly used for optical bioprobes. Our favourite nanomaterials are lanthanide-based fluorides ($MLnF_4$, M = alkali metal, Ln = lanthanides and Yttrium), and our research addresses challenges in their synthesis as well as the establishment of structure-property relationships. The growing attention toward such optically active materials has prompted the development of novel synthesis methods for a more reliable and efficient access to these systems. In this regard, microwave-assisted approaches provide unique advantages over traditional solvothermal methods reliant on convectional heating: namely, significantly shorter reaction durations, more rigid reaction conditions, and thus a higher degree of reproducibility. The developed approach allows to control the material's crystalline phase and doping of various Ln^{3+} ions into core/shell architectures.[1] Additional surface modification with biopolymers renders the nanomaterials dispersible in various solvents and allows for their assembly into multipurpose micro-carriers. The resultant emission colour tuneable upconverting nanoparticles are promising candidates for versatile applications, ranging from multiplexed imaging and light-induced therapy to inks for printing of micropatterns for optoelectronic devices.

References

1- Halimi I, Rodrigues EM, Maurizio SL, Sun T, Grewal M, Boase EM, Liu N, Marin R, Hemmer E (2019) J. Mater. Chem. C. 7: 15364-15374