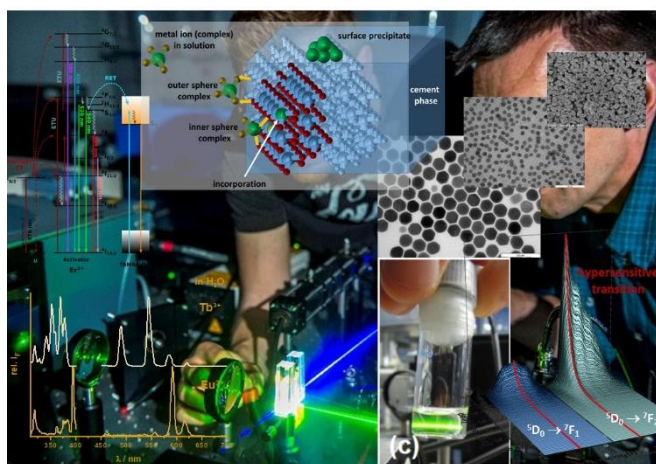


Applied Optical Sensors and Spectroscopy

Description



The working group *Applied Optical Sensors and Spectroscopy* of apl. Prof. Michael Kumke focuses its research on lanthanides, which are used as luminescence probes in the life and environmental sciences as well as in clinical diagnostics in *down shifting* and *frequency upconversion* applications. In case of frequency upconversion, the

electromagnetic radiation required for excitation is in the NIR range. In this area, water and other biological materials show only a low intrinsic absorption. Therefore, the potential for optically-based sensors with applications in the life and environmental sciences is **outstanding**. Special attention is hereby paid to the production of novel lanthanide-containing nanoparticles whose surface is modified with biomarkers. Other ongoing research projects include bio-inspired filter materials for lanthanide recovery, physico-chemical processes in the near and far field of repositories, nanoparticles for SOEC/SOFC applications, and the remote detection of leaks in hydrogen lines.

Spectrum of Methods

Absorption spectroscopy, steady-state emission spectroscopy, time-resolved emission spectroscopy (TCSPC, box car, streak camera), pump probe experiments (transient absorption, flash photolysis), high-resolution emission spectroscopy in condensed phase (fluorescence line narrowing, Shpol'skii spectroscopy), Raman microscopy, temperature programmed oxidation/reduction

Literature

- Bastian et al., **Bioinspired confinement of upconversion nanoparticles for improved performance in aqueous solution**, J. Phys. Chem. C, 2020, 124, 52, 28623-28635.
- Chemura et al., **Europium doped Ceria-Gadolinium mixed oxides : PARAFAC and high-resolution emission spectroscopy under cryogenic conditions for structural analysis**, J. Phys. Chem. A, 2020, 124, 4972-4983.
- Burek et al., **Lanthanide luminescence revealing the phase composition in hydrating cementitious systems**, ChemistryOpen 8, 2019, 1441-1452.

Applications

- Optical sensors
- Bioanalytics
- Hydrogen research
- Repository safety research
- Catalyst materials

Keywords

- Frequency upconversion nanoparticles (UCNP)
- Lanthanides
- Luminescence probes
- Fluorescence probes
- Remote detection

Interest in cooperation

- Research-based collaboration
- Contract research
- Industry-sponsored research

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