

## Multifunctional optical sensors for nanomanometry and nanothermometry: high-pressure and high-temperature upconversion luminescence of lanthanide-doped phosphates—LaPO<sub>4</sub>/YPO<sub>4</sub>:Yb<sup>3+</sup>–Tm<sup>3+</sup>

### Autorzy

Marcin Runowski

Andrii Shyichuk

Artur Tymiński

Tomasz Grzyb

Víctor Lavín

Stefan Lis

### Rok wydania

2018

### Czasopismo

ACS Applied Materials and  
Interfaces

### Numer woluminu

10

### Strony

17269-17279

### DOI

10.1021/acsami.8b02853

### Kolekcja

Naukowa

### Język

Angielski

### Typ publikacji

Artykuł

### Streszczenie

Upconversion luminescence of nano-sized Yb<sup>3+</sup> and Tm<sup>3+</sup> codoped rare earth phosphates, that is, LaPO<sub>4</sub> and YPO<sub>4</sub>, has been investigated under high-pressure (HP, up to ~25 GPa) and high-temperature (293–773 K) conditions. The pressure-dependent luminescence properties of the nanocrystals, that is, energy red shift of the band centroids, changes of the band ratios, shortening of upconversion lifetimes, and so forth, make the studied nanomaterials suitable for optical pressure sensing in nanomanometry. Furthermore, thanks to the large energy difference (~1800 cm<sup>-1</sup>), the thermalized states of Tm<sup>3+</sup> ions are spectrally well-separated, providing high-temperature resolution, required in optical nanothermometry. The temperature of the system containing such active nanomaterials can be determined on the basis of the thermally induced changes of the Tm<sup>3+</sup> band ratio (<sup>3</sup>F<sub>2,3</sub> → <sup>3</sup>H<sub>6</sub>/<sup>3</sup>H<sub>4</sub> → <sup>3</sup>H<sub>6</sub>), observed in the emission spectra. The advantage of such upconverting optical sensors is the use of near-infrared light, which is highly penetrable for many materials. The investigated nanomanometers/nanothermometers have been successfully applied, as a proof-of-concept of a novel bimodal optical gauge, for the determination of the temperature of the heated system (473 K), which was simultaneously compressed under HP (1.5 and 5 GPa).

### Słowa kluczowe

energy transfer, lifetimes, Ln<sup>3+</sup>-doped luminescent nanoparticles, upconversion optical pressure and temperature gauge, nanomaterials' compression in DAC, rare earth ions

### Adres publiczny

<http://dx.doi.org/10.1021/acsami.8b02853>

<https://www.acs.org/content/acs/en.html>

Plik został wygenerowany dnia 2026-10-09 19:25:52

Adres w repozytorium <https://old.chem.uni.wroc.pl/pl/repozytorium/E5RhzuP>.