

Simultaneous Temperature and Pressure Detection Based on Mn²⁺ Luminescence

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Temperature and pressure sensing based on luminescence offers several key advantages over conventional approaches, including remote readout, high spatial resolution, fast response, and the possibility of real-time remote monitoring under extreme or confined conditions.[1] These features make luminescent probes particularly attractive for applications where traditional sensors fail, such as high-pressure environments, microelectronics, or chemically aggressive media. Simultaneous monitoring of temperature and pressure is of particular importance, as these two parameters are inherently coupled - pressure often increases with temperature, leading to cross-sensitivity effects that can significantly distort measurement accuracy. As a result, the development of optical sensors capable of decoupling these two variables remains a critical challenge in the field of luminescent sensing.

In this work, we demonstrate that phosphor doped Mn²⁺ enable independent and reliable readout of both temperature and pressure, by exploiting optimized spectroscopic responses of the activator ions, based on luminescence intensity ratio (LIR). These approach allows for selective sensitivity to each parameter, thereby minimizing cross-interference.

The proposed system exhibits high relative sensitivity for both temperature and pressure, along with excellent repeatability and stability. This work highlights the potential of transition metal-doped phosphors as robust tools for simultaneous, decoupled sensing of temperature and pressure, opening new opportunities for advanced diagnostics in complex environments.

This work was supported by the Foundation for Polish Science under First Team FENG.02.02-IP.05-0018/23 project with funds from the 2nd Priority of the Program European Funds for Modern Economy 2021-2027 (FENG).

[1] Brites C. D. S., Marin R., Suta M., Carneiro Neto A. N., Ximendes E., Jaque D., Carlos L. D. (2023) Adv. Mater., 35, 2302749.

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