物 理 科 学 談 話 会 の ご 案 内

講　師:Prof. Fernando Palacio

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演　題:**Thermometry in the nanoscale**

日　時:4月25日(水)16:00 ～ 17:30

場　所:大阪府立大学 A12棟サイエンスホール

※多数の方々のご来聴を歓迎いたします。

連絡先:理学系研究科 物理科学専攻　細越　裕子(内線4053)

Abstract:

Temperature is a fundamental thermodynamic variable, the measurement of which is crucial in countless scientific investigations and technological developments, accounting at present for 75%–80% of the sensor market throughout the world. The traditional liquid-filled and bimetallic thermometers, the thermocouples, the pyrometers and the thermistors are generally not suitable for temperature measurements at scales below 10 μm. This intrinsic limitation has encouraged the development of new non-contact accurate thermometers with micrometric and nanometric precision, a challenging research topic increasingly hankered for.

This work describes absolute temperature sensing/mapping − in the 10-350 K range and submicrometer spatial resolution − using magnetic siloxane-based hybrid nanoparticles (NPs) co-doped with Eu^{3+} and Tb^{3+} tris(β-diketonate) chelates. This unique luminescent self-referencing nanothermometer has been recently reported by us [1,2]. The developed thermometer has up to 4.9%·K^{-1} temperature sensitivity (1.5 times larger than the highest value reported previously) and it exhibits high photostability for long-term use. The variation of the Eu^{3+}/Tb^{3+} ratio affords tunability to the temperature working range as shown in Figure 1. Alternatively, tunability is also accomplished by changing the host matrix, thus modifying the interaction between the Ln^{3+} and the host matrix energy levels.

The nanothermometer is a versatile material which can be processed in different forms adapted to the desired application, e.g. a thick film coating an integrated circuit trough which we obtain a high resolution 2-D temperature mapping epicted in Fig. 2. The presentation will also include an account on current state of the art of thermometry at the nanoscale and in particular of lanthanide-based luminescent molecular thermometry.

[1] a) C.D.S. Brites, P.P. Lima, N.J.O. Silva, A. Millán, V.S. Amaral, F. Palacio, L.D. Carlos, Adv. Mater., 2010, 22, 4499;

b) F. Palacio, A. Millán, N. J. Silva, L. D. Carlos, V. Amaral, P. P. Lima, C. D. S. Brites, Spain Patent P200930367, 2009.

[2] C.D.S. Brites, P.P. Lima, N.J.O. Silva, A. Millán, V.S. Amaral, F. Palacio and L.D. Carlos, New J. Chem., 2011, 35, 1177.