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It's Getting Hot in Here: Intracellular Temperature Sensing Through Light Emission

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The emergence of luminescent nanothermometry during the last decade opened up the possibility of measure thermal flows at spatial scales below 10 μm, unreachable by conventional electrical methods.[1] Diverse phosphors capable of providing a contactless thermal reading through their light emission properties have been examined, e.g., polymers, DNA or protein conjugated systems, organic dyes, quantum dots, and trivalent lanthanide (Ln^{3+}) ions incorporated in organic-inorganic hybrids, multifunctional heater-thermometer nanoplatforms, upconverting, downconverting and downshifting nanoparticles. The implementation of these Ln3+-based phosphors (with an emphasis in upconverting nanoparticles) as ratiometric thermometers was extensively reviewed in the past five years.[1]
In the last couple of years, the focus of luminescence thermometry has gradually shifted from the fabrication of more sensitive nanoarchitectures towards the use of the technique as a tool for thermal bioimaging and the unveiling of properties of the thermometers themselves and their local surroundings, as, for instance, the instantaneous ballistic velocity of Brownian nanocrystals suspended in both aqueous and organic solvents.[2]
After a general perspective of the work done on luminescence nanothermometry since the explosion of the field at one decade ago, the lecture will be focused on a recent example[3] illustrating the potential of the technology to measure the intracellular temperature.

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Aurophilic Luminescent Hydrogels

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Metallogels are a subject of study in the last few years.[1] The reason for the growth of interest stems from the availability and the diversity of metal-ligand coordination that could readily induce or control the self-assembly process of the gel formation and thereby influence the gel properties, as a difference with what occurs in organic gels. Organometallic Au(I) complexes present the additional advantage to use both classical supramolecular interactions (e.g. π–π stacking or hydrogen bonding) together with the establishment of Au(I)···Au(I) bonds (aurophilic interactions), which are particularly strong. Furthermore, these complexes exhibit interesting emissive properties that usually are modulated by the presence of the aurophilic interactions, display sup-picosecond intersystem crossing rate constants[2] and can display thermally assisted delayed fluorescence (TADF) with short luminescence decay times and a high PL quantum efficiency[3], important properties for OLED emitters.
We have reported on the formation of luminescent Au(I) hydrogels based on water soluble organometallic alkynyl complexes where aurophilic intermolecular interactions are involved on the gelation process.[4-8] Slight modifications on the chemical structure can induce significant changes on the supramolecular assemblies leading to hydrogels, rods or vesicles (Figure 1).

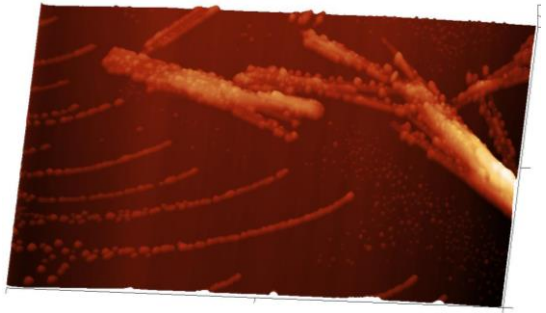

Figure 1: AFM image showing the hierarchical self-assembly from vesicles to fibers and bundles of [(PTA)Au(4-pyridylethynyl)] in water (PTA = 1,3,5-triaza-7-phosphaadamantane).

Analysis of the thermodynamic and photophysical parameters that modulate and are modulated, respectively, by Au(I) and Au(I)...Au(I) interactions has been performed and the results are supported by theoretical data.

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