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## White-emitting organometallo-silica nanoparticles for sun-like light-emitting diodes

Authors : Elisa Fresta, Cintia Ezquerro, Elena Serrano, Elena Lalinde, Javier García-Martínez,Jesús R. Berenguer, and Rubén D. Costa
Affiliations : Elisa Fresta, Rubén D. Costa:.IMDEA Materials Institute, Calle Eric Kandel 2, E-28906 Getafe, Madrid (Spain). Cintia Ezquerro, Elena Lalinde, Jesús R. Berenguer: Departamento de Química-Centro de Investigación en Síntesis Química (CISQ), Universidad de La Rioja, Madre de Dios, 53, E-26006, Logroño, La Rioja (Spain). Elena Serrano, Javier García-Martínez: Laboratorio de Nanotecnología Molecular, Departamento de Química Inorgánica, Universidad de Alicante, Ctra. Alicante-S. Vicente s/n, E-03080 Alicante (Spain).

Resume : Light-emitting diodes (LEDs) represent one of the most important technological progress of the 20th century, as it allowed us to obtain light as primary product of their working mechanism, with efficiencies as high as 80%. They are based on inorganic semiconductor materials coated with a color down-converting phosphor. However, commercial inorganic phosphors rely on rare earth materials, which leads to high production cost and uncertain availability for the future. Additionally, their bad color quality is considered a health concern.[1] This led to the rise of hybrid organic-inorganic LEDs, which feature an organic phosphor.[2] There are two major challenges in the hybrid white LED (HWLED) field. Firstly, there is the need to develop new color down-converting coatings with enhanced photo- stabilities and thermal management. Secondly, there is a strong need of white-emitting single-component down-converting coatings, to circumvent problems related to self-absorption, phase separation, and color instability caused by mixing two or more different emitters. Herein, we provide a pioneering synthesis method demonstrating the first example of single-component white-emitting hybrid organometallo-silica nanoparticles using a new synthetic approach. In short, the latter is based on the kinetic control of the initial formation of emissive organometallic dots of about 5 nm of diameter, via the condensation of three emitting iridium(III) complexes bearing terminal alkoxysilane groups, prior to the growth of the mesoporous silica nanoparticles.[3] These novel nanoparticles show one of the highest photoluminescence quantum yields for white emission (20%), that is remarkably stable under different irradiation and temperature stress scenarios. This finding encouraged us to employ the white-emitting hybrid silica nanoparticles as color down-converting coatings and/or packagings for HWLEDs. The latter featured an excellent color quality, which closely matches the sunlight spectrum, spherical light distribution, and stability over thousands of hours (<2% decrease for >1500h under continuous operation conditions). As a matter of fact, both color quality and stability of our WHLEDs are the best reported up to date. We believe that the versatility and simplicity of our new synthesis approach, as well as the excellent optical properties and stability of our hybrid nanoparticles and devices may open new and exciting opportunities for the design and fabrication of new single component white emitters and HWLEDs. [1] K.M. Zielinska-Dabkowska, Make Lighting Healthier, Nature. 553 (2018) 274–276. [2] E. Fresta, V.F. Luna, P.B. Coto, R.D. Costa, Merging Biology and Solid-State Lighting: Recent Advances in Light-Emitting Diodes Based on Biological Materials, Adv. Funct. Mater. (2018) DOI:10.1002/adfm.201707011. [3] C. Ezquerro, E. Fresta, E. Serrano, E. Lalinde, J. Garcia-Martinez, J.R. Berenguer, R.D. Costa, Three-in-one: White-emitting organometallo-silica nanoparticles for single-component hybrid light-emitting diodes, Mater. Horiz. (2018) (Submitted.)