Temperature-controlled switchable photochromism in solid materials

Julià-López Alex[1], Hernando Jordi[2], Ruiz-Molina Daniel[1], González-Monje Pablo[1], Sedó Josep[1], Roscini Claudio[1]

[1] Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC and The Barcelona Institute of Science and Technology, Campus UAB, Bellaterra, 08193 Barcelona, Spain

[2]Departament de Química, Universitat Autònoma de Barcelona, Edifici C/n, Campus UAB, 08193 Cerdanyola del Vallès, Spain

E-mail: claudio.roscini@icn2.cat

The light induced darkening of photochromic materials is a very attractive phenomenon which, to date, is mainly exploited for photoprotective coatings.[1] More recently, the development of spiropyran and spirooxazine systems that can reversibly switch between positive (photochrome darkens upon radiation and fades in the dark) and negative (the opposite) photochromism has gained much interest, since it allows frequency-dependent photoinduced optical effects exploitable for controlling input/output optical signals in logic gates, information recording/processing and rewritable printing devices.[2] To date most of the reported examples showing switchable photochromism were developed as proof-of-concept bulk liquid solutions where external chemicals (i.e. acids, metal ions) had to be sequentially added or removed to alter the relative stability of spiro (SP) and merocyanine (MC) isomers from which the corresponding photochromism could take place.[3] Positive/negative photochromism interconversion in solid materials without addition of any external agent or chemical modification of the photochromic compound remains so far a challenge.

Herein we report a universal and straightforward strategy to achieve this goal based on the use of core-shell polymeric capsules containing an acidic phase change material (PCM) solution of spiropyran dyes.[4] While the shell guarantees confinement within a solid matrix, the phase change transition of the PCM allows the interconversion from positive to negative photochromism at will using temperature as a stimulus. By embedding these capsules in polymeric matrices, we were able to transfer the temperature-controlled switching behavior to the final solid material (Figure 1). This approach, which does not involve the addition/removal of external additives, neither the chemical modification of the dyes, could be of relevance for the future fabrication of photofunctional materials for flexible, lightweight and low-cost devices, such as writing/erasing displays and optical memories.

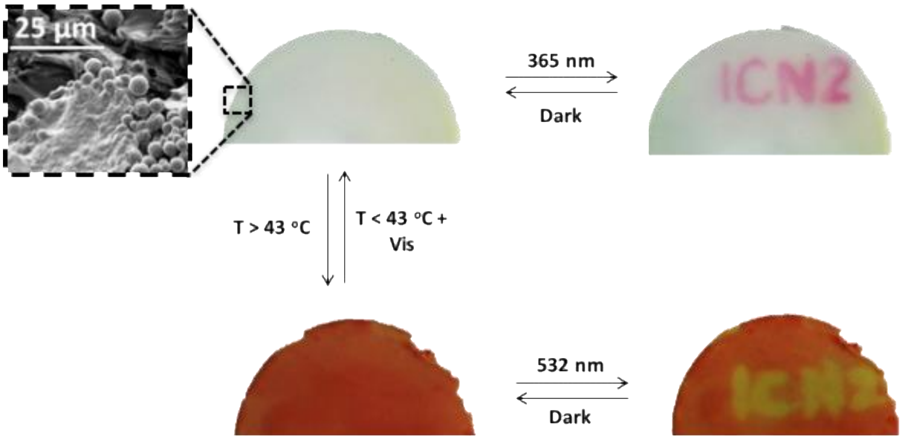

Figure 1. Polymeric films containing PCM-core capsules, showing positive and negative photochromism below and above the melting point of the encapsulated PCM.

Funding: Spanish Government and FEDER funds with the projects MAT2015-70615-R, CTQ2015-65439-R and Severo Ochoa Program with the Grant SEV-2013-0295.

References:

[1] S. Nigel Corns, S. M. Partington, A. D. Towns, *Color. Technol.* **2009**, 125, 249

[2] U. Pischel, *Angew. Chem. Int. Ed.* **2007,** 46, 4026

[3] F. M. Raymo, S. Giordani, *J. Am. Chem. Soc.* **2001**, 123, 4651

[4] A. Julià-López, J. Hernando, D. Ruiz-Molina, P. González-Monje, J. Sedó, C. Roscini, *Angew. Chem., Int. Ed.*, **2016**, 55, 15044