Light processing of nanoporous semiconducting oxides for the fabrication of optically active thin films

J.R. Sánchez-Valencia[1], A. Borrás[1,2], V.J. Rico[1], S. Hamad[1] , A. Barranco[1], J.P. Espinós[1], A.R. González-Elipe[1]

[1] Instituto de Ciencia de Materiales de Sevilla (CSIC-Univ. Sevilla), Spain
[2] Nanotech@surfaces Laboratory, EMPA Materials Science and Technology, Thun, Switzerland.
Corresponding author e-mail: jrsanchez@icmse.csic.es

UV illumination of semiconducting oxides as TiO_2 and Ta_2O_5 has been proved as an effective procedure for enhancing the photo-activity of these materials in a subsequent photo-activated process [1-2]. However, despite the existing literature, to our knowledge there have been no systematic studies trying to explore the possibilities of using the illumination of these materials surfaces as an additional tool for developing new processing procedures. In this communication we present a series of experiments showing how the irradiation of these thin films behave differently face to the preparation of composite materials prepared by infiltration. This investigation has been carried out with porous TiO_2 and Ta_2O_5 thin films prepared by Plasma Enhanced Chemical Vapour Deposition (PECVD) and/or Electron Evaporation procedures [2]. These layers present well controlled porosities consisting of meso- and/or micropores. The preparation of two types of functional nanocomposite materials is intended by infiltration. They consist of dye (Rhodamine 6G and Rhodamine 800) molecules used as laser dyes and silver in the form of nanoparticles, both of them embedded within the semiconducting thin films. Dye thin films in mesoporous semiconducting thin films have been proposed for good candidate for laser materials [3]. Silver particles presenting well resolved plasmon structures have been also studied because of their interesting applications as sensor and “camaleonic” materials [4]. In the present work, we studied the relation between thin film microstructure, optical properties, surface energy variations and the distribution of the dye/metal nanoparticules when the layers are exposed to post-deposition light irradiation treatments. We believe that the reported findings open new ways for a tailored synthesis of composite optical materials.

References:

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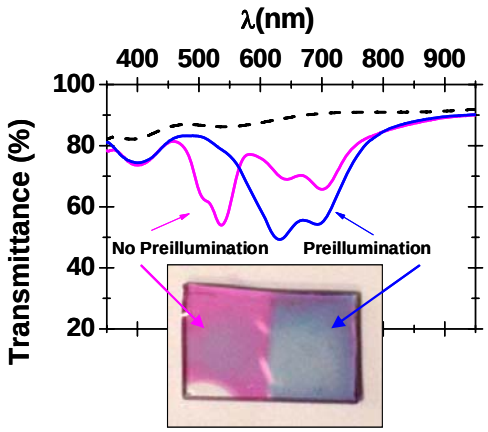

Fig 1. UV-vis transmission spectra of Ta_2O_5 thin films immersed in a solution of Rh-6G and Rh-800 for pre-illuminated and non illuminated samples.