CuO nanostructures: follow-up of their formation in microemulsions, functionalization and hydrophobic coatings

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CuO nanotapes have been prepared by the novel oil-in-water microemulsion reaction method under mild conditions [1]. The microemulsion system used for synthesis was water / Synperonic 91/5 / isooctane. The surfactant:water weight ratio (S:W) was 25:75, and the concentration of oil phase was 14 wt%. The oil phase contained copper (II) 2-ethylhexanoate as organometallic precursor; NaOH was used as precipitating agent. The method allows the formation of nanotapes of CuO with a monoclinic crystalline structure at room temperature, without the need for calcination.

Samples were taken at different reaction times in order to analyze by HRTEM and follow the evolution of the nanostructures. During the first minutes, long nanocables, made up of rhombohedral $Cu(OH)_2$ were formed. At about 10-20 minutes of reaction the nanocables started to merge, which finally became nanotapes of monoclinic CuO after a few hours. The crystallite size as estimated by the Debye-Scherrer equation was 15.6 nm. The thickness of the nanotapes was under 10 nm, whilst its width was between 20 to 60 nm and its length between 200 to 400 nm. The nanotapes self-aseembled into a leaf-like structure. The bandgap of the CuO nanotapes was 1.42 eV, compared to the value of bulk CuO of 1.2 eV. The nanotapes presented mesopores of around 2 nm. A film of CuO nanotapes onto glass was prepared by spin-coating technique, and functionalization was carried out by immersing the substrate into a solution of 1-dodecanethiol for several hours. Functionalization was confirmed by XPS and FTIR. Water contact angle of this dodecanethiol-CuO film was about 147º, which is almost superhydrophobic. This result was attributed to both the hydrocarbon functionalization and the hierarchical structure obtained from deposition of the leaf-like CuO nanotapes. Thus, the obtained material could be of interest for its application as self-cleaning smart coating [2].

In order to improve its potential for this application, Ag NPs prepared by a modified-Tollens method were deposited onto CuO nanotapes. Ag NPs can act as a co-catalyst in photodegradation processes. HRTEM studies were consistent with successful deposition process. Furthermore, Ag NPs may improve the functionalization with dodecanethiol due to its chemical affinity to the thiol group. The obtained results highlight the potential of this strategy towards the development of smart coatings.

Acknowledgements. We are grateful to CONACYT-SENER, Fondo Sectorial de Sustentabilidad Energética (CEMIESOL P21).

[1] M. Sánchez-Domínguez, K. Pemartin, M. Boutonnet, *Curr. Opin. Colloid Interface Sci.,* 2012, **17**, 297.
[2] S. Gao, Z. Li, K. Jiang, H. Zeng, L. Li, X. Fang, X. Jia, Y. Chen, *J. Mater. Chem.*, 2011, **21**, 7281.