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Morphological Characterization of Electrodeposited Zinc-based Matrix Composites

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Research at the nanometer scale, aiming to create novel materials and devices offering better performance than those of macro/micro systems, is currently of great relevance in many topics of modern science, technology and engineering [1]. In what concerns coatings technology, the nanocomposite films can offer excellent properties in different applications [2, 3], representing their morphological characterization a great challenge.

Electrodeposition is widely used for preparing nanocomposite coatings because of its low cost and versatility. Moreover it enables the occlusion of a wide range of nanosized particles into matrices. The nanocomposite characteristics are influenced by the deposition parameters, namely current profile, bath composition, pH, particles concentration and temperature [4, 5].

TiO_2 nanoparticles are one of the most extensively studied materials because of its remarkable optical and electrical properties, increasing availability, low cost, high chemical stability and their almost environmental photocatalyst behavior. However, there are still a lot of problems needed to be solved in practical applications of TiO_2 nanoparticles for photocatalysis. One way to enhance the photocatalytic activity is its use in coating nanocomposite materials, including metal and semiconducting matrices. The coupling two semiconductors provide a novel approach to achieve better corrosion protection and mechanical properties. Additionally, more efficient charge separation, increased lifetime of the charge carriers, and enhanced interfacial charge transfer to adsorbed substrates, are reached [6, 7].

The morphological characterization was performed by Scanning Electron Microscopy (SEM) that enabled the high-resolution visualization of the nanocomposite films surface prepared by electrodeposition.

The goal of this work is to show how TiO_2 nanoparticles present in nanocomposite films influence the morphology of Zn (Figure 1) and ZnO (Figure 2) matrices, to be used as materials in photoelectrocatalysis.

The as-deposited Zn-TiO_2 surface is rougher and more irregular than the Zn films (Figure 1a and b, respectively). As it can be seen the nanoparticles promote the decrease of matrix grain size. A similar behavior was observed for the ZnO based nanostructured films (Figure 2). For the ZnO sample prepared in the absence of TiO_2 particles, the formation of arrays of oriented ZnO nanorods occurs (Figure 2b). Due to the presence of nanoparticles, the film is composed of many flower-like ZnO agglomerates (Figure 2a and c) made up of numerous hexagonal straight nanorods. The diameter of ZnO nanorods significantly decreases in the presence of the TiO_2 nanoparticles in the bath.

References

1. Fernandez *et al.*, Analytical and Bioanalytical Chemistry 396 (1): 15-29
2. J.H. Hsieh *et al.*, Thin Solid Films 518 (24): 7263-7266
3. J.M. Yeh *et al.*, Journal of Industrial and Engineering Chemistry 14 (3): 275-291
4. T. Frade *et al.*, Surface and Coatings Technology 204 (21-22): 3592-3598
5. J. Fustes *et al.*, Journal of Solid State Electrochemistry 12 (11): 1435-1443
6. T. Frade *et al.*, Journal of Electrochemical Society 158 (3): C63-C70
7. D. L. Liao *et al.*, Journal of Photochemistry and Photobiology A: Chemistry 194 (1): 11-19

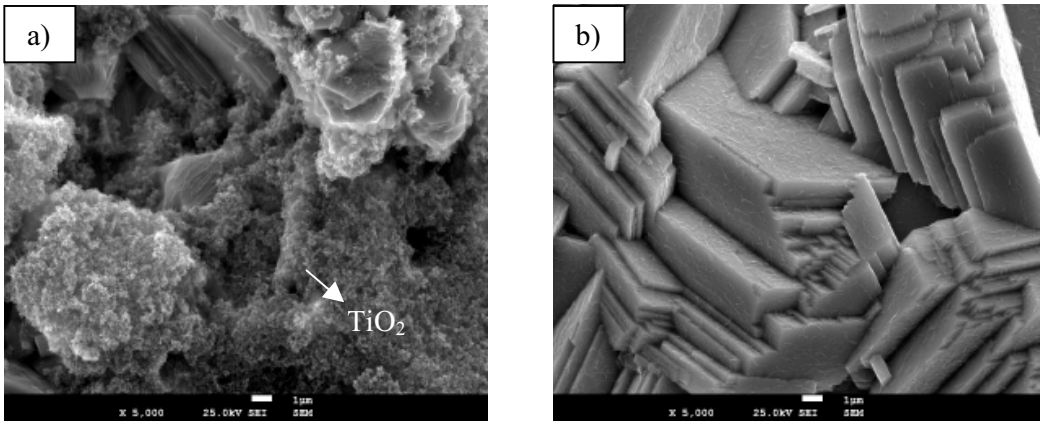

Figure 1. SEM image of Zn-TiO_2 (a) and Zn (b) prepared by electrodeposition, in steel substrate, from acidic sulphate bath.

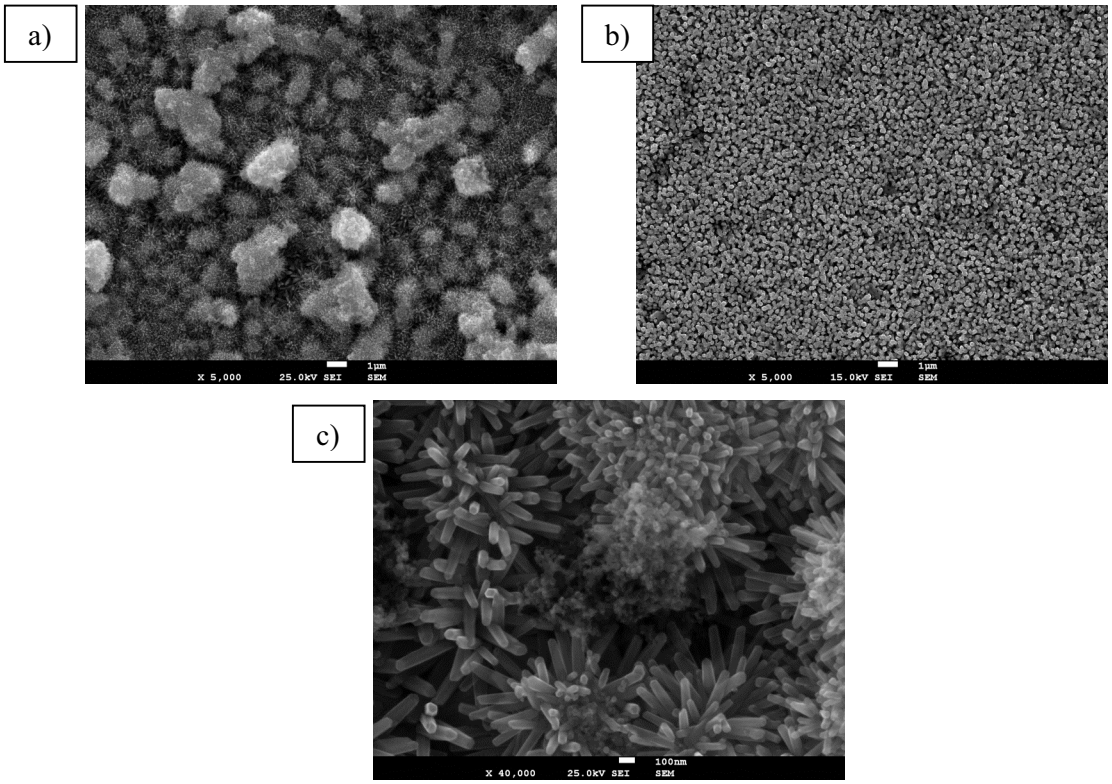

Figure 2. SEM image of ZnO-TiO2 (a and c) and ZnO (b) prepared by electrodeposition in FTO substrate, from zinc nitrate bath.

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