TiO_2-SiO_2 nanocomposite photoactive mesoporous materials for self-cleaning applications

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Mesoporous TiO_2-SiO_2 composites that have photocatalytic activity have been synthesized by mixing ethoxysilane oligomers and TiO_2 nanoparticles in the presence of a non-ionic surfactant (*n*-octylamine) [1]. The products synthesized have a clear practical application because they can be employed outdoors by means of a simple and low-cost process. The resulting nanomaterials give self-cleaning properties and create crack-free effective adhesive coatings for porous building materials. In addition, they improve the mechanical resistance of the substrate. Another important advantage of these nanocomposites is that they substantially improve protection against salt crystallization degradation mechanisms [2].

The use of N_2 physisorption, atomic force microscopy and electron tomography, together with 3D reconstructions, permits us to conclude that the texture of the nanocomposites synthesized is a key parameter to control the photocatalytic activity. Specifically, we find that *n*-octylamine creates a mesoporous SiO_2 structure in which TiO_2 nanoparticles are embedded, and that TiO_2 and SiO_2 are present in separate domains in the bulk of the material. The mesoporous structure enhances the activity of the material by improving access to photoactive sites [3].

We optimize the effectiveness of these photocatalysts on stone by varying loading and particle size of TiO_2. We find that the integration of around 4% w/v content of TiO_2 nanoparticles into the SiO_2 network significantly improves their effectiveness due to a higher availability of photoactive sites. For a higher TiO_2 loading (10% w/v), photoactivity decreases because the porous volume is drastically reduced and subsequently, a more difficult access to photoactive sites is produced. Regarding to the particle size effect, we observe that larger and sharper TiO_2 nanoparticles enhance the photoactivity effect [4].

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