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Electron Microscopy and Photocatalytic Studies of 1D TiO_2 Nanostructures Synthesized by Two Different Routes

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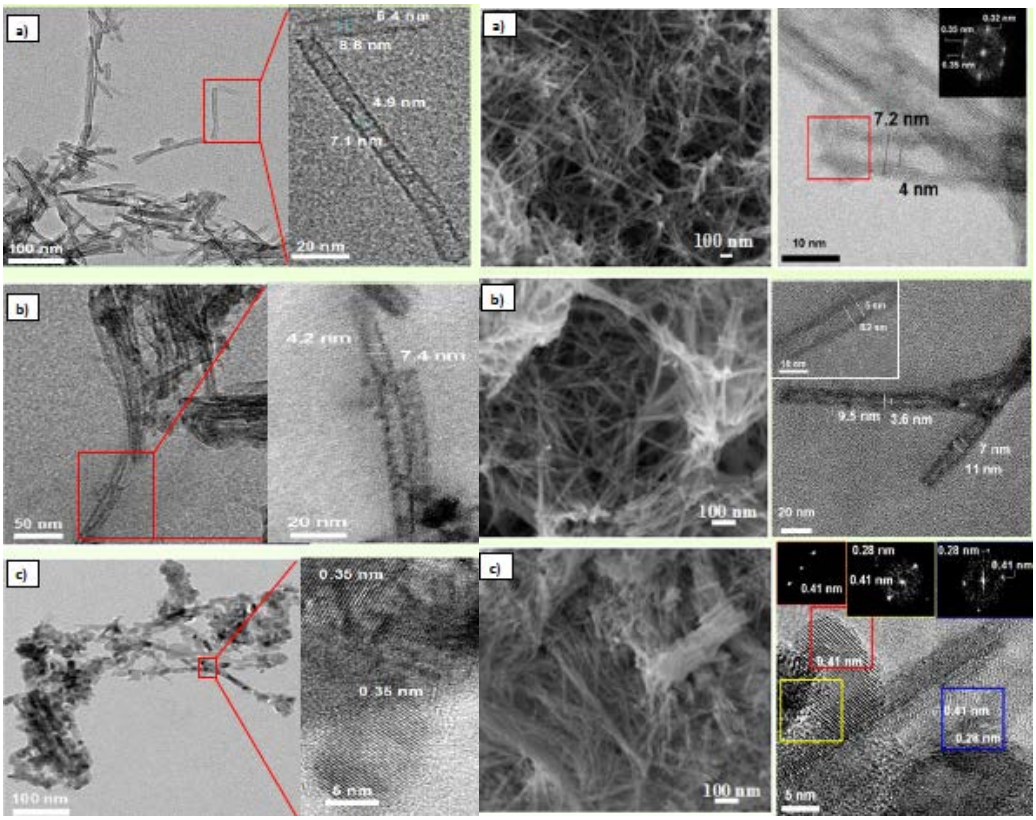
Nanotubes/nanorods (1D) TiO_2 nanostructures of around 8 nm in diameter were synthesized by alkaline hydrothermal treatment of sol-gel made TiO_2 or P-25 TiO_2 . Anatase like 1D TiO2 nanostructures were obtained in both cases. The 1D nanostructures made using seeds from Sol Gel TiO2 nanopowders turn on rodlike nanostructures and presents lower surface area than the nanostructures made from commercial TiO_2 P-25 (97 y 279 m2/g, respectively). In both cases, the 1D structures shown lower photocatalytic activity than P25 nanopartcles. However, the rodlike nanostructures obtained from TiO_2 Sol Gel seeds displayed slightly higher efficiency than the original seeds. Despite the higher surface area shown by the nanostructures, the photocatalytic efficiency did not improve with respect to their precursor seeds. This phenomenon can be associated with the presence of other of structures like particles, nanoribbons or a kind of sheets with lower crystallinity and even amorphous phases.

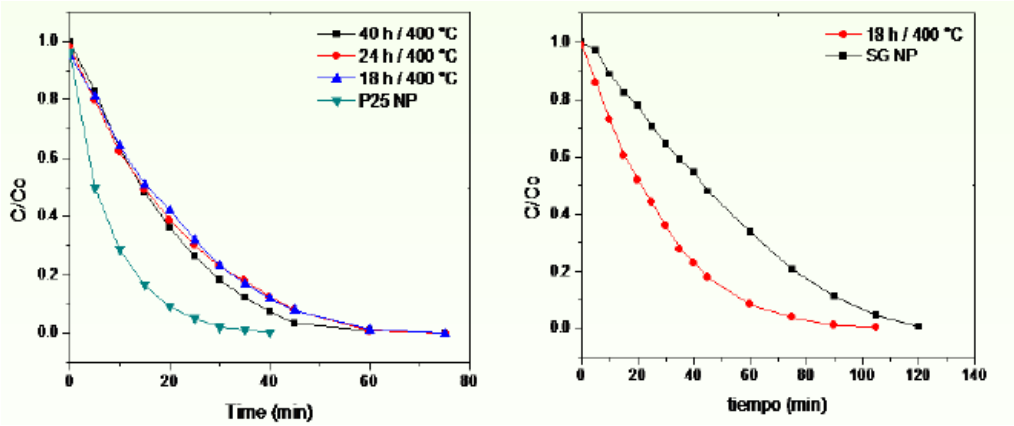
TiO2 nanomaterials are well-studied and commonly used materials for liquid and gas-phase photocatalytic applications due to its high performance photocatalysis for water splitting and for degradation of organics [1]. In the last years one-dimensional nanostructures such as nanotubes, nanorods, nanowires, nanobelts, etc. of inorganic materials have attracted great attention because they could offer larger surface area in comparison to nanoparticles [2]. In this work, we report de synthesis of nanotube and rodlike shape TiO2 nanostructures by hydrothermal synthesis using seeds of: TiO_2 nanopowders synthesized by So Gel method in our laboratory and commercial TiO_2 P-25. We have studying the effect of hydrothermal treatment time and the influence of the starting materials in the morphology, thermal stability and their photocatalytic activity. The obtained nanotubes and nanorods were compared with their corresponding starting materials to evaluate their photocatalitic performance under the degradation of an organic pollutant as Rhodamine B (RhB).

Photocatalytic efficiency for degradation of RhB was carried out under the radiation of Ultravitalux 220 W OSRAM ultravitalux lamp, with a measured mean radiation Intensity of 60 W/m2 in the UV-A range. An aqueous solution with initial volume of 150 mL was prepared with an amount of 0.050 g catalyst and RhB 10 ppm, the solution was stirred first in the dark for 30 min to ensure that the RhB was adsorbed to satura-tion on the catalysts. The decrease of the RhB concentration was determinate as a function of the irradiation time from the change in absorbance at 564 nm.



FE-SEM images (left) and TEM and HRTEM images (right) of 1D nanostructures obtained from P25 TiO_2 hydrothermally treated for 18, 24 and 40 h with further acid treatment and annealed at 400°C (a, b and c)

TEM images of 1 d TiO_2 nanoestructures obtained from Sol Gel NP hydrothermally treated for 18 h (a), after acid treatment (b) and after annealing at 400 °C (c).



A comparison of the degradation of RhB solutions of P25 nanoparticles and the corresponding 1D nanostructures (left) and Sol Gel nanoparticles and the corresponding 1D nanostructures (right) can be done from these graphics.

References

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