Low Temperature Synthesis of Photocatalytic Mesoporous TiO_2 Nanomaterials

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Nanostructured materials exhibit outstanding size/shape dependent properties that make them extremely promising in several application fields. The urgent environmental issues such as water and air pollution have focused increasing efforts in developing photoactive nanoparticles, especially nanosized TiO_2, with the goal to achieve the complete mineralization of pollutants by means of the well-known photocatalytic generation of reactive oxygen species (ROS).[1,2]
However, the lack of scalable and cost-effective synthetic routes has so far significantly hampered the large-scale application of the nanosized photocatalysts for environmental purposes. Therefore, a technologically viable synthetic approach able to provide TiO_2 NPs with an adequate morphological and structural control and with high reaction yield is urgently needed.

We report the synthesis of mesoporous TiO_2 nanostructures based on the decomposition of $TiOSO_4$ in aqueous alkaline solution at room temperature, followed by mild thermal treatment (110 °C) in an oven and suitable to yield up to 40 g of product per batch. The duration of the thermal treatment was found to be crucial to control crystalline phase composition, specific surface area, surface chemistry and, accordingly, the photocatalytic properties of the obtained TiO_2 nanocrystals. The thorough investigation of the prepared samples allowed us to explain the relationship between the structure of the obtained nanoparticles and their photocatalytic behavior, that was tested in a model reaction. In addition, the advantage of the mild treatment against a harsher calcination at 450 °C was illustrated. The proposed approach represents a facile and sustainable route to promptly access an effective photocatalyst, thus holding a significant promise for the development of solutions suitable to real technological application in environmental depollution.[3]

References

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