Exploring the photo-catalytic properties of Nb_2O_5 nanoparticles synthesized by different procedures

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Abstract

Niobium-containing materials have been prominent in recent decades because of their special applications in the high technology industries, especially in the aerospace, metal super alloy and electro-electronics sectors. The properties of Nb_2O_5 strongly depends on its synthesis procedure as well as on the conditions of ulterior thermal treatment [1]. We report the synthesis of Nb_2O_5 powders prepared by the sol-gel precipitation method using niobium(V) ethoxide as precursor. Two chemical routes were chosen: the presence of tryethyl amine (TEA) as precipitant/template agent, or the oxidant peroxide method. Microwave-assisted activation (MW) was also used. Portions of Nb_2O_5 powders synthesized by the above procedures were amorphous. Structural changes upon heating from room temperature up to 800ºC were investigated by XRD technique combined with thermo-gravimetric analysis. The sequential thermal treatment up to 800ºC promotes the crystallization of hexagonal phase to orthorhombic phase whereas the ulterior cooling to room temperature lead to a mixture of both phases. Samples calcined at selected temperatures of either 600ºC or 800ºC for 2 h, were characterized by a wide variety of techniques. The synthetic procedure as well as the combined MW-activation followed by ulterior thermal treatment lead to changes not only on particle size but also on the textural properties of the catalysts. The photo-activity of the synthesized catalysts has been evaluated using Rhodamine B (RhB) as a substrate, under both UV and visible lighting conditions. None of the catalysts synthesized showed activity in the visible. Under UV illumination, some of the catalysts exhibited a relatively low photo-activity in the degradation of RhB, which is associated with a photosensitizing effect. However, the addition of Ag^+ ions considerably increased the activity of all the catalysts implementing considerably the degradation of RhB under UV-illumination leading to a new silver metallized sample.

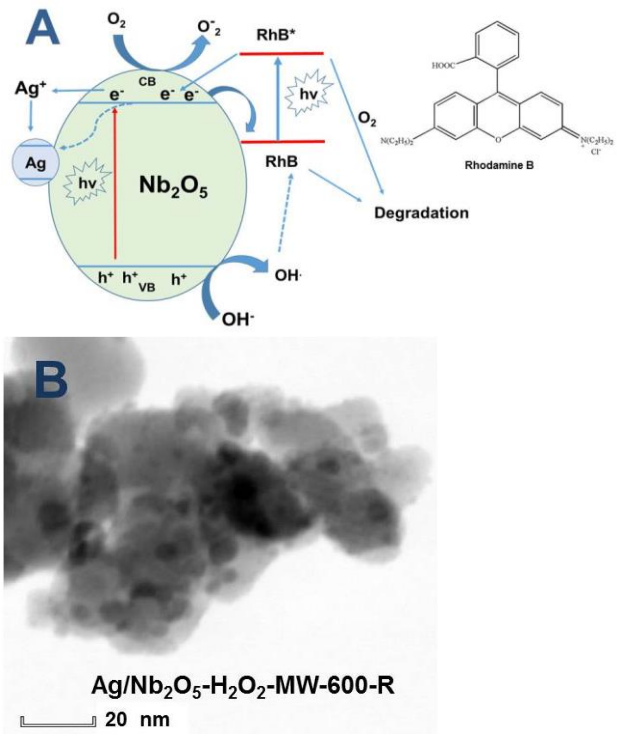

Figure 1: (A) A proposal of the degradation mechanism of RhB in the presence of Nb_2O_5 under UV-lighting conditions. **(B)** Selected TEM for the indicated sample.

References

[1] A.M. Raba, J. Barba-Ortega, M.R. Joya, The effect of the preparation method of Nb_2O_5 oxide influences the performance of the photocatalytic activity, Appl. Phys. A Mater. Sci. Process. 119 (2015) 923–928.