Ultrasound-assisted synthesis of WO_x-decorated ZnO photocatalysts for NO_x abatement

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Heterojunctions based on ZnO have numerous applications, such as water splitting, sensing and energy storage [1]. Recently, ZnO/WO_3 composites have shown promising results in the sonocatalytic and photocatalytic degradation of aqueous and gas pollutants [2]. Several synthetic approaches have been reported, including chemical vapor deposition, magnetron sputtering, hydrothermal methods and high temperature annealing. Ultrasound-assisted synthesis can provide a scalable and cost-effective strategy to tailor the catalyst structural and morphological properties [3]. In the present work, pristine ZnO and ZnO/WO_x composites were synthesized via a sonochemical method, studying the role of the ultrasound amplitude and mode (continuous/pulsed), metal precursor, WO_x content and post-synthetic annealing. The resulting materials were extensively characterized, investigating their structural, morphological, optical, and surface properties. Samples were tested towards the photocatalytic removal of NO_x under both UV and visible light irradiation in a batch reactor. A good degree of crystallinity is appreciable even before calcination and better morphological features are observed with respect to reference samples prepared without ultrasounds. The morphological properties can be further tuned by changing the metal precursor and adding a post-synthetic annealing step. Photocatalytic activity is promoted with respect to both benchmark samples (Figure 1).

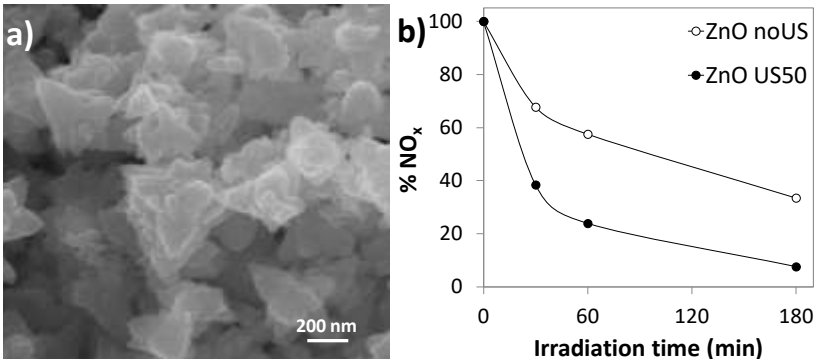

Figure 1. a) SEM image of uncalcined ZnO; b) photocatalytic NOx degradation under UV.

[1] Han et al. *Adv. Mater. Interfaces* **2018**, *5*, 1701167; Meroni et al., *Chem. Commun*. **2015**, *51*, 10459. Meroni et al., *Appl. Catal. B* **2015**, *178*, 233.
[2] Hunge Y.M. et al., *Ultrason. Sonochem.* **2018**, *45*, 116; Gasparotto A. et al., *CrystEngComm*, **2018**, *20*, 1282.
[3] Bianchi C.L. et al., *Ultrason. Sonochem.* **2018**, 40, 282.