

ZnO nanowires-on-quartz for efficient water purification: The issue of Volatile organic compounds (VOCs) degradation using solar energy.

Lan GAO^{1,2}, Martine GNAMBODOE-CAPOCHICHI², Elyes NEFZAOU¹, Frédéric MARTY¹,
Tarik BOUROUINA¹, Yamin LEPRINCE-WANG²

¹ Université Paris-Est, ESYCOM CNRS FRE2028, ESIEE PARIS-93162, Noisy le Grand, France

² Université Paris-Est, ESYCOM CNRS FRE2028, UPEM-77420, Champs sur Marne, France

The photocatalysis is proved to be the most efficient way for the degradation process of organic pollutants [1]. ZnO and TiO₂ are supposed to be the most common photocatalysts due to their high performance in degradation by producing the oxidative free radical after being illuminated by UV light. Taking the advantages of these chemical properties, the environmental applications were developed by many research groups using micro-nano technologies [2,3]. Furthermore, ZnO has biocompatibility advantage, and easy to obtain the high aspect ratio nanowires (NWs) via low-cost synthesis method with the further advantage of being firmly anchored to the substrate, leading to more sustainable applications.

Here we report on ZnO NWs-on-quartz based photocatalysis for water purification, more specifically, the VOCs contaminants, which have been chosen because these pollutants cannot be removed by conventional purification such as steam generation, as shown in Figure 1 (a). SEM observation (Figure 1(b)) showed homogeneous ZnO NW array successfully grown using hydrothermal synthesis method on a quartz substrate (transparent to solar radiation including UV spectrum). Thus, our demonstration combines both steam generation and photocatalytic degradation to obtain purified water. UV-Visible spectrometry revealed a gap value of 3.23eV, while the theoretical value is 3.30 eV. Simultaneously, targeting the degradation of VOCs in the water, a series of validation experiments showed that our ZnO NWs have a good photocatalytic efficiency as shown in our previous work in the case of the microfluidic chamber [4], confirmed both by UV-Vis spectrometry and gas chromatography.

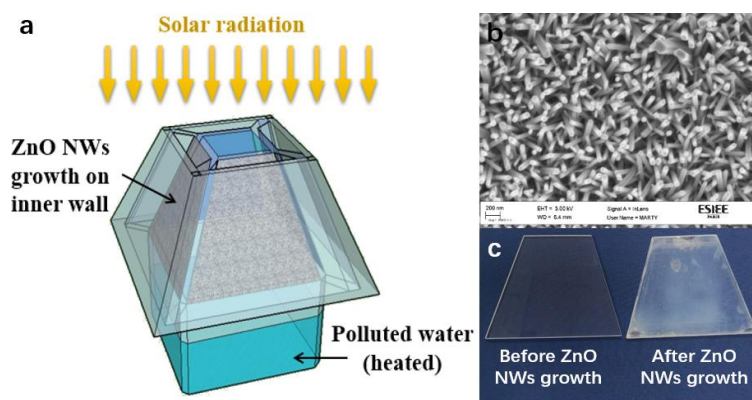


Figure 1 (a) Demonstration of the reaction chamber. (b) SEM image of ZnO nanowires. (c) ZnO nanowires growth on quartz samples.

Acknowledgements

This work is supported by the ISITE FUTURE Initiative (Ref ANR-16-DEX-0003) in the frame of the project NANO-4-WATER.

Reference

- [1] Dimapilis, E. A. S., Hsu, C.-S., Mendoza, R. M. O. & Lu, M.-C. Zinc oxide nanoparticles for water disinfection. *Sustain. Environ. Res.* **28**, 47–56 (2018).
- [2] Nie, L., Duan, B., Lu, A. & Zhang, L. Pd/TiO₂@ Carbon Microspheres Derived from Chitin for Highly Efficient Photocatalytic Degradation of Volatile Organic Compounds. *ACS Sustain. Chem. Eng.* **7**, 1658–1666 (2018).
- [3] Chakrabarti, S. & Dutta, B. Photocatalytic degradation of model textile dyes in wastewater using ZnO as semiconductor catalyst. *J. Hazard. Mater.* **112**, 269–278 (2004).
- [4] Azzouz, I. *et al.* Zinc oxide nano-enabled microfluidic reactor for water purification and its applicability to volatile organic compounds. *Microsyst. Nanoeng.* **4**, 17093 (2018).