Crystalline ZnO photocatalysts with different morphologies prepared at ambient temperature

Julien Mahy[1,2], Louise Lejeune [1], Tommy Haynes [1], Nathalie Body [1], Simon De Kreijger [1], Benjamin Elias [1], Raphael Henrique Marques Marcilli [3], Charles-André Fustin [3], Stéphanie D. Lambert [2], Sophie Hermans [1]

[1] Université catholique de Louvain, Molecular Chemistry, Materials and Catalysis (MOST), Institute of Condensed Matter and Nanosciences (IMCN), Louvain-la-Neuve, Belgium ; [2] Université de Liège, Nanomaterials, Catalysis and Electrochemistry (NCE), Department of Chemical Engineering, Liège, Belgium; [3] Université catholique de Louvain Institution, Bio and Soft Matter Division (BSMA), Institute of Condensed Matter and Nanosciences (IMCN), Louvain-la-Neuve, Belgium (corresponding author: julien.mahy@uliege.be)

ABSTRACT:

Since the industrial revolution, technological advances have generated enormous emissions of various pollutants affecting all ecosystems. Pollutants detection and degradation have therefore become critical issues. Numerous remediation technologies have already been developed such as biological remediation, physicochemical and electrochemical methods. Among these techniques, advanced oxidation processes (AOPs) have been popularized in the treatment of wastewater. The use of ZnO as photocatalyst for water remediation is developing fast in recent years. In this work, the goals are to produce ZnO photocatalysts with different morphologies by using a green sol-gel process and to study both the influence of the synthesis parameters on the resulting morphology and the influence of these different morphologies on the photocatalytic activity for the degradation of an organic pollutant in water. Multiple morphologies were produced (nanotubes, nanorods, nanospheres; Figure 1) with same crystalline phase (wurtzite) as confirmed by XRD. The most important parameter controlling the shape and size was found by a detailed statistical study to be the pH. The photoactivity study on a model pollutant degradation shows that the resulting activity is mainly governed by the specific surface area of the material. A comparison with a commercial TiO_2 photocatalyst (Evonik P25) showed that the best ZnO produced with this green process can reach similar photoactivity without any calcination step [1].

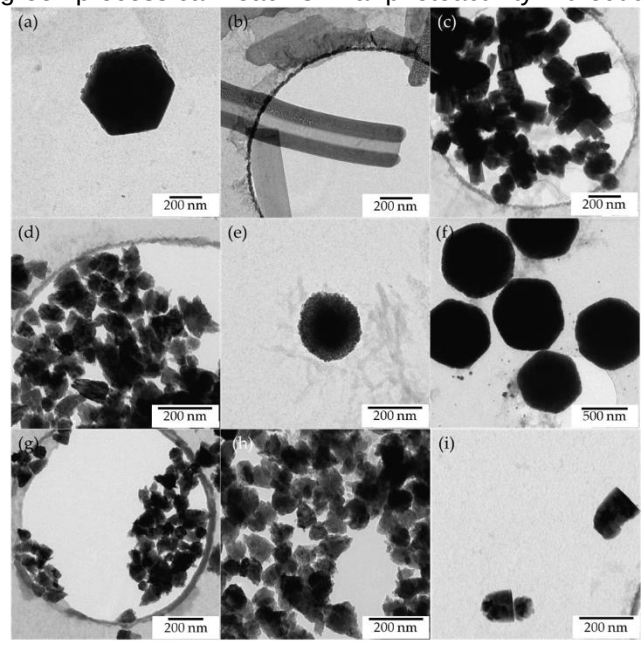

Figure 1: TEM images of nine ZnO samples a) hexagon, b) nanotube, c-d) nanorods, e) nanosphere, f) hexagon, g-h-i) nanorods in which different morphologies of the obtained nanoparticles and agglomerates can be clearly appreciated.

References

1- Mahy J G, Lejeune L, Haynes T et al. (2021) Catalysts 11(10) 1182