Supercritical antisolvent precipitation to produce zinc oxide nanoparticles for the photocatalytic degradation of dyes

Paola Franco[1], Olga Sacco[2], Vincenzo Vaiano[1], Iolanda De Marco[1]*

[1]Department of Industrial Engineering, University of Salerno,
Via Giovanni Paolo II, 132, 84084, Fisciano (SA), ITALY
[2]Department of Chemistry and Biology "A. Zambelli", University of Salerno,
Via Giovanni Paolo II, 132, 84084, Fisciano (SA), ITALY

*corresponding author: idemarco@unisa.it

Nowadays, organic dyes are the main pollutants in the wastewater coming from different industrial activities, including textile, paper, rubber, and plastic manufacturing processes. Because of their toxicity and carcinogenicity, dyes are a serious problem for the environment and the health of living organisms. Conventional treatments used to remove dyes from the wastewater, such as biological, physical and chemical methods, have as main limit the low removal efficiency, since dyes are stable to the light and the oxidizing agent. This drawback can be overcome by using heterogeneous photocatalysis, which is an advanced oxidation technology. Zinc Oxide (ZnO) is one of the most promising semiconductors to treat the colored wastewater by photocatalytic methods.

It is well known that the morphology and particle size of semiconductors strongly affect the physical and chemical properties and, thus, the photocatalytic performance.

Supercritical Antisolvent (SAS) technique is an innovative route to prepare the precursors of nanopowder catalysts, characterized by controlled dimensions and reduced solvent residues.

In this work, Zinc acetate (ZnAc) nanoparticles were prepared by SAS precipitation to produce a high-activity ZnO for the photocatalytic treatment of wastewater. Two model dyes were chosen, namely crystal violet dye (CV) and Eriochrome Black T (EBT), to compare the ZnO obtained from the thermal decomposition of SAS ZnAc nanoparticles and of unprocessed ZnAc. SAS-prepared ZnO showed the best activity performance for the degradation of dyes under UV irradiation with respect to the ZnO from unprocessed ZnAc, thanks to the complete removal of organic residues in ZnO and to the particle size reduction.