Potential of ZnO nanowires for the photocatalytic elimination of nanoplastics in polluted waters

Context :

Among all the environmental pollution sources, the problem of micro and nanoplastics (MNP) pollution has emerged as an urgent concern, raising questions about the environmental impact, both on ecosystems and human health [1,2]. The omnipresence of MNP poses significant challenges in terms of detection and removal from aquatic environments. Conventional methods, such as filtration, coagulation, sedimentation and adsorption quickly reach their limits when faced with the colloidal characteristics of MNPs, which makes their removal particularly complex [3].
The photocatalytic degradation of these substances, using metal-oxide semiconductors (mostly TiO2 et ZnO), activated by UV and visible irradiations, effectively reduces the organic load associated with MNPs [4,5]. The MNP usually detected are (i) Polystyrene (PS), (ii) Polyethylene (PE) and (iii) Polyethylene Terephtalate (PET), produced from the fragmentation of common plastic materials (packaging, plastic bags, textiles…).
Thanks to their high specific surface area, it has been shown that ZnO nanowires (NWs) are promising candidates for water treatment, whether for soluble pollutants [6,7] or micrometer-scale MNP (300 µm) [8].

The aim of this project is to study capacity of ZnO NWs to degrade sub-micrometer scale MNPs by photocatalysis, and to observe this degradation through ex-situ measurements using SEM, AFM, SNOM (Scanning Near-field Optical Microscopy) and FTIR (Fourier-Transform InfraRed spectroscopy).

Internship objectives:

The internship includes ZnO nanomaterial synthesis and its advanced characterization:
- Hydrothermal synthesis of ZnO NWs (over Si/ZnO substrates) and their structural characterisation (MEB, AFM, DRX)
- Immersion of samples in solution containing NPs (and maybe MP)
- Ex-situ characterisation of the samples using MEB / AFM / SNOM / FTIR : NW alone, NW with MNPs
- Aging of the sample under irradiation:
    - study of exposure duration, effect of wavelength
    - study of the NW density and length effect
    - study of the MNP size

[1] T. Gouin et al., Envir. Toxicol. Chem. (2019) https://doi.org/10.1002/etc.4529
[2] S. Cavazzoli et al., Envir. Monit. Assess. (2023) https://doi.org/10.1007/s10661-023-12030-x
[3] C.E. Enyoh et al., Micro (2025) https://doi.org/10.3390/micro5020017
[4] I. Nabi et al., iScience (2020) https://doi.org/10.1016/j.isci.2020.101326
[5] S. Singh et al., ACS Applied Materials & Interfaces (2024) https://doi.org/10.1021/acsami.4c06616
[6] M. Le Pivert et al., Catalysts (2022) https://doi.org/10.3390/catal12101231
[7] M. Bousmaha et al., Ceramics Int. (2024) https://doi.org/10.1016/j.ceramint.2024.04.104
[8] E. A. Daher et al., Environmental Research (2025) https://doi.org/10.1016/j.envres.2025.121836

Location:
GREMAN (EMA pole), Parc Grandmont Bât. E, 20 avenue Monge, 37200 TOURS
+ GREMAN (MTC pole), 26 rue Pierre et Marie Curie, 37100 TOURS
https://greman.univ-tours.fr
+ CERTeM platform, 26 rue Pierre et Marie Curie, 37100 TOURS, https://certem.univ-tours.fr

Period:
6 or 5 mois, from February/March 2026

Remuneration :
Approx. 610 € net per month

Candidate profile:
This internship is open to motivated and curious students enrolled in a Master of Science program or engineering school, with a strong background in chemistry, physics, or materials science..

Application procedure:

Please send your CV, undergraduate transcript and cover letter to:

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