DEGRADATION OF PET NANOPLASTICS USING TiO_2/MIL-100(Fe) PHOTOCATALYST UNDER SOLAR IRRADIATION

"Priority" emerging pollutants in the hydrocycle: microplastics, nanomaterial, PFAs and PPCPs

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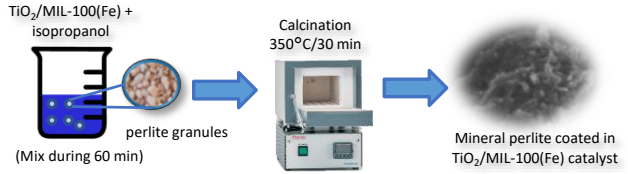
Introduction

The occurrence of microplastics (MPs, <5 mm) and nanoplastics (NPs, <1 μm) in the marine environment is raising strong concerns since they can have potentially negative effects on human health. Polyethylene terephthalate (PET) is a common polymer found in aquatic environments and the influents and effluents of wastewater treatment plants due to the growing global consumption and their resistance to degradation [1]. Heterogeneous photocatalysis (HP) is a useful treatment technology for removing nanoplastics (NPs) from water due to its high efficiency, low cost, and operation facility [2]. This study investigated the photocatalytic activity of TiO_2/MIL-100(Fe) of PET NPs degradation in an aqueous solution under solar radiation.

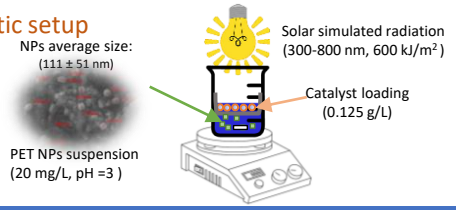
Experimental part

A) Catalyst synthesis

B) Coating of TiO_2/MIL-100(Fe) on perlite



C) Photocatalytic setup



Results and discussion

Table 1. Physicochemical properties of the materials.

Sample	BET surface area (m^2/g)[A]	Crystallite size (nm)[B]	Eg (eV)[C]
MIL-100(Fe)	732.1	-	1.73
TiO_2	128.2	4.0	3.03
TiO_2/MIL-100(Fe) 12.5%	179.0	3.7	2.63

[A]N_2 physisorption. [B]XRD analysis. [C]UV-Vis DRS spectroscopy.

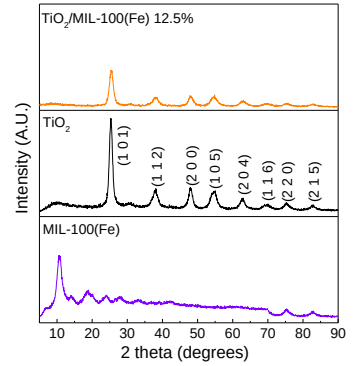


Fig. 1. XRD analysis of samples.

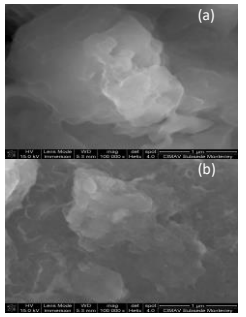


Fig. 2. SEM of PET (a) before and (b) after treatment using TiO_2/MIL-100(Fe) 12.5% photocatalyst.

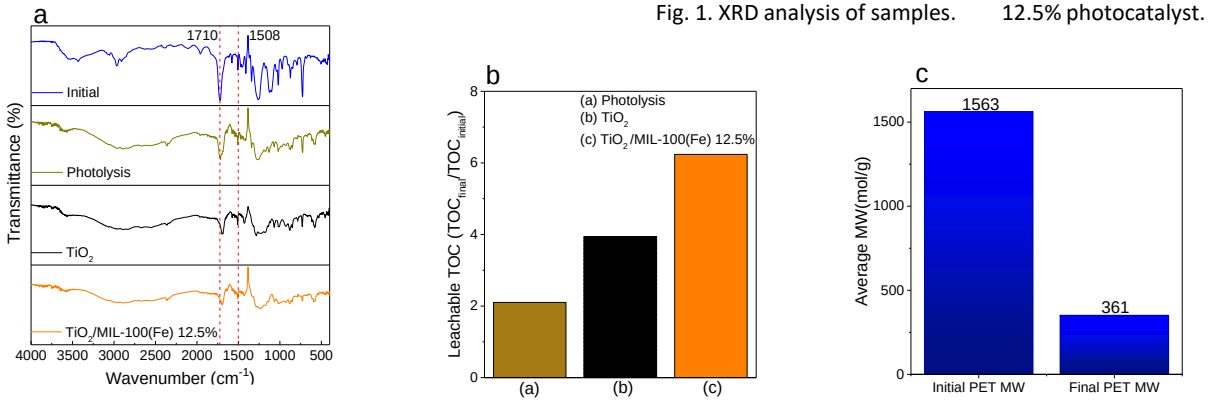


Fig. 3. FTIR of PET NPs before and after treatment (a), leachable TOC during PET NPs photocatalytic degradation (b), and gel-permeation chromatography results of PET NPs before and after treatment (c).

Conclusions

FTIR analysis and TOC measurements indicated that the TiO_2/MIL-100(Fe) photocatalyst presented an improved performance in degrading PET NPs than TiO_2. The degraded PET NPs exhibited morphological changes and reduced molecular weight, attributed to the main chain scission during the treatment using TiO_2@MIL-100(Fe) photocatalyst.

References

[1] A.G. Rodríguez-Hernández, et al. Environ Sci Nano, 6 (2019) 2031-2036.
[2] P.H. Allé, et al. Environ Chem Lett, 19 (2020) 1803-1808.

Acknowledges

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