Mimicking the environmental ageing of polymers for the preparation of model microplastics

Margaux Glais*[†1], Guigo Esthe Nonnonhou[‡1], Fabienne Lagarde[§1], Christophe Chassenieux[¶1], Elise Deniau[‖1,2], and Thierry Falher**[3]

[1]iMMM – Institute of Molecular and Materials of Le Mans – UMR-CNRS 6283, Le Mans University, 70285 Le Mans, France – Université du Mans, France
[2]IPREM – IPREM-UMR 5254/LCABIE – Université de Pau et des Pays de l'Adour, France
[3]IPC – CT IPC – 2 Rue Pierre et Marie Curie, 01100 Bellignat, France

Abstract

UV radiation from the sun, mechanical abrasion from waves, currents and sand or the action of micro-organisms lead to the breakage of plastic waste into microplastics (MPs) and nanoplastics (NPs). Researches on the toxicity of such particles on living organisms have rapidly increased these last years. Their studies rely on MPs/NPs that either have undergo no environmental constraints which makes them not that relevant or that are sampled form the environment with a poor knowledge on their chemical composition. Here, we propose a methodology for reproducing the mechanisms of the degradation and the generation of MPs/NPs occurring in the aquatic environment in order to provide, at the lab scale, particles closer to those found in the environment. In that attempt, we combine photodegradation and mechanical stress, which have been proven to be of most importance in the crossover from macro plastics to MPs and NPs. We will notably compare two ways of applying mechanical stress ie cryomilling *vs* soft stress (gentle stirring in solution) after a UV ageing step starting from selected plastics of controlled composition. We will show that the resulting MPs display a variety of sizes and shapes more representative of real ones than the commercial microbeads often used for impact studies. The microparticles generated by the soft stress protocol takes longer time to be produced but are more stable in water than those obtained by cryo-milling and their chemical composition is furthermore more homogeneous. These two protocols appear promising to produce MPs of controlled sizes and morphologies and in amounts relevant for considering their use for reproducible impact studies.

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*Speaker
[†]Corresponding author: margaux.glais@ct-ipc.com
[‡]Corresponding author: enonnonhou@cttm-lemans.com
[§]Corresponding author: fabienne.lagarde@univ-lemans.fr
[¶]Corresponding author: christophe.chassenieux@univ-lemans.fr
[‖]Corresponding author: elise.deniau@univ-lemans.fr
**Corresponding author: thierry.falher@ct-ipc.com