# Self-reinforced polylactic acid (SR-PLA) is more resistant to releasing microplastic than polypropylene (PP) after UV irradiance

Niu Zhiyue[1], Catarino Ana Isabel[1], Le Gall Maelenn[2], Curto Marco[3], Demeyer Elke[4], Asselman Jana[5], Jassen Colin R[5], Dhakal Hom[3], Davies Peter[2] and Everaert Gert[1]

[1] Flanders Marine Institute (VLIZ), Jacobsenstraat 1, 8400 Oostende, Belgium
E-mail: zhiyue.niu@vliz.be
[2] Marine Structures Laboratory, IFREMER, Centre de Bretagne, 29280, France
[3] Advanced Materials and Manufacturing Research Group, School of Engineering, University of Portsmouth, Portsmouth PO1 3DJ, UK
[4] Functional Thermoplastic Textiles, Centexbel, Industriepark Zwijnaarde 70, 9052 Gent, Belgium
[5] Blue Growth Research Lab, Ghent University, Bluebridge Building, Ostend Science Park 1, 8400, Ostend, Belgium

The over-dependence on petroleum-based polymers has led to a series of environmental issues, including the occurrence and persistence of microplastic (MP), in the global ocean. Polymers made from a natural-sourced feedstock, known as bio-based polymers, are hypothesized to be more sustainable alternatives. However, our knowledge remains limited about their degradation and fate in the marine environment. Plastic debris in the marine environment is known to break down to smaller sizes and release MPs under ultraviolet (UV) radiation. A number of studies have provided evidence of the release of MP from larger debris under UV radiation in laboratory conditions, observed via weight loss, changes in average particle size and SEM observations. However, the most direct and quantitative evidence of MP formation, i.e. observation, identification and enumeration of MPs formed after UV radiation, is limited. Until now, only a few studies have assessed the weathering of bio-based polymers and their capacity to form MPs. Here, we aim to assess the MP formation of a bio-based polymer, self-reinforced polylactic acid (SR-PLA), and a petroleum-based polymer, polypropylene (PP), during weathering by UV radiation. To do so, we exposed 3D printed cylinders (surface area = 4.7 $cm^2$) of SR-PLA and PP, immersed in filtered natural seawater, to accelerated UV radiation for 57 and 76 days, simulating 18 and 24 months of mean natural solar irradiance in Europe. Dark controls (i.e. sealed vials from UV, n = 6) were incubated in the same conditions for the same durations. To identify, characterise and quantify the formed MPs, we used a combination of fluorescent microscopy, infrared technology (µFT-IR) and image analysis. The average concentration of released SR-PLA MPs (≥50µm) per surface area was 3.9 ± 2.0 # / $cm^2$ in UV exposures and 1.6 ± 0.8 # / $cm^2$ in dark controls. For PP, this was 53.4 ± 46.3 # / $cm^2$ and 0.9 ± 0.9 # / $cm^2$, respectively. For both polymers, higher MP concentrations were found after 76 day UV radiation ($p<0.05$, Dunnett's test) compared to samples kept in dark. The PP cylinders released significantly more MPs than SR-PLA after UV exposure ($p<0.05$, Dunnett's test), indicating that the bio-based polymer SR-PLA is more resistant to releasing MPs than the petroleum-based polymer PP after UV irradiance. We anticipate that our results will contribute to assessing the sustainability of future bio-based polymers and to informing a transition process to more sustainable plastic materials.

**Keywords**
Microplastic Formation; Bio-Based Polymer; Ultraviolet; Plastic Pollution