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Thin polymer films as a model platform for the study of microplastic formation

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Plastic is present in our daily live and its production is increasing significantly. In 1950, 1 million tons of plastic were produced, in 2016 this figure rose to 396 million tons. The end of life of plastic waste is still poorly managed, and some of them are found in the seas and oceans [1]. Once in the natural environment, the various environmental factors such as solar radiations, bioactivity, temperature lead to their aging and fragmentation. Fragment sizes can range from micrometric to nanometric scale making possible the ingestion of plastics for species at the base of the food chain as for larger mammals.

As a consequence, studying the aging and the fragmentation mechanism of polymers raises environmental and health issues. Since it is particularly difficult to monitor all these processes in the real environment, laboratory studies are still necessary to obtain more accurate data to identify the pathways leading to the formation and size distribution of microplastics.

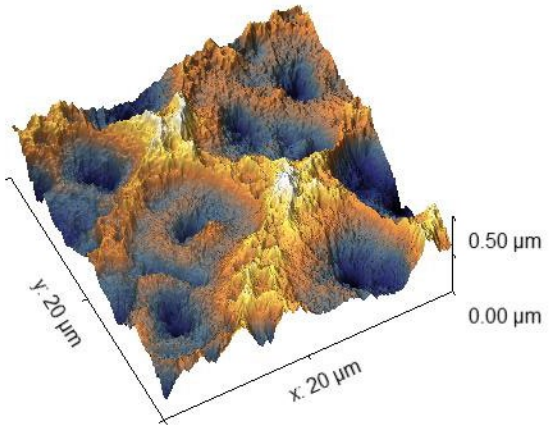

Figure 1 : AFM 3D-topography image of a LDPE thin film weathered for 73 days showing the difference of morphology between spherulitic

Previous results [2-4] have shown the strong influence of thermal history and crystalline morphology on the fragmentation pathway of polyolefins (Figure 1) or biodegradable polymer. In order to understand the influence of these parameters, it is interesting to have samples for which these parameters can be controlled.

In this presentation we will present the elaboration of thin LDPE films where the crystalline morphology, thickness and surface roughness can be controlled. Then, by performing accelerated weathering experiments, the effect of these physico-chemical parameters on the degradation pathway will be presented. Finally, we will show that this strategy can be adapted to study the fragmentation of other polymer such as biodegradable polymers.

[1] R. Geyer, et al., Science Advances, **3**, e1700782 (2017)
[2] F. Julienne et al., Polymer Degradation and Stability, **170**, 109012 (2019)
[3] F. Julienne et al., Chemosphere, **236**, 124409 (2019)
[4] T. Gaillard, et al., Soft Matter, **15,** 8302 (2019)