***Title of Research:***

22-D-01 Elucidation of the mechanism and rate of microplastic formation contributing to risk assessment and preparation of standard microplastics

***Principal Investigator:***

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***Summary of Research:***

MP collected in the lower reaches of the Arakawa River were sorted and observed. The MP pellets were ball-milled with glass beads. The results showed that as the size of the MPs decreased, they became more spherical in shape. All MPs that were surface peeled off in the ball milling test were less than 1 mm in diameter, indicating that the MPs changed from flaky MPs to particle-like MPs. This is interpreted to indicate that the formation mechanism of MPs is similar to that of rocks converted to gravel by river transport (i.e., collapse by mechanical action).

The iPP sheets were exposed to high temperatures, and the results showed that the thermally deteriorated sheets had localized bleaching and yellowing in the peripheral areas, while a healthy area remained in the central part. In the bleached areas, cracks were formed due to shrinkage caused by chemical crystallization and propagated in one direction, forming a columnar structure. In the yellowing area, chemical crystallization progressed further and some of the cracks collapsed to form fine powder of about 0.2 mm in diameter.

Dumbbell pieces punched from PET bottles, PE sheets, and PP sheets were exposed to a xenon weather meter, and the results showed that photo-oxidation degradation progressed significantly in PP, with a marked decrease in molecular weight and mechanical properties, and cracks appeared and developed. The molecular weight of PET also decreased, and cracks appeared on the surface in a mosaic-like pattern, and some of the cracks appeared to be peeling off and collapsing.

Based on the above findings, it is considered that the collapse and exfoliation of the "weathering layer" generated by the cracks that occur with the degradation of plastics are deeply related to the generation of MP. The formation mechanism of this "weathering layer" can be explained by a pattern formation in which shrinkage propagates, as is the case with dry cracks.

The aerosols were classified and collected for analysis by pyrolysis GC/MS, and the pyrolysis GC/MS allowed the identification and quantification of atmospheric MPs without any special pretreatment. The fact that no pretreatment is required is also important to prevent contamination.

On the other hand, the use of a blade-type jet mill with many blades in a swirling stream of compressed air, which is an improvement over conventional jet mills, has made it possible to reduce various plastics to near-spherical particles of approximately 10 μm in diameter. Furthermore, UV irradiation of atomized plastics in a mixed solvent of acetone and alcohol enabled efficient surface oxidation.

***Timeline:*** March 2022-.

***Topics:*** Online presentation at the 2022 LRI Research Report Meeting

***Publications:*** Presentations: (Only the PI's international presentation)

1) Shinichi Kuroda, ” Elucidation of the formation mechanism of microplastics”, Microplastics Advance Research and Innovation Initiative (MARII) Workshop on “Advancements and steps towards a holistic, quantitative risk assessment on microplastics”, 12 - 13 October 2022 (Online).