

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:

The purpose of this research is quantitative elucidation of the formation mechanism of microplastics under natural environments and development of a method for the preparation of “reference” microplastics for risk assessment. We conducted X-ray microbeam analysis of plastics degraded in the natural environment by outdoor exposure tests. We found that the depth profile of the crystallinity was explained by the weathering layer model proposed by our group. We have analyzed PET bottles collected in the Arakawa riverbed. We found that degradation is not obvious even after outdoor exposure for 20 years, suggesting the PET bottle may not be important as the source of microplastics. We also analyzed airborne microplastics by using the pyrolytic GC/MS. We found that the size of rubber particles was significantly larger than those of PET particles. The kinetic analysis for microplastic formation was conducted by using the ultraviolet exposure tests. We found that the crack propagation speed during the ultraviolet exposure tests is significantly faster than that during the high-temperature exposure tests, suggesting the acceleration of microplastics formation by the ultraviolet irradiation. We prepared the spheric particles of polyethylene and polypropylene by using cryogenic milling technique, where the typical size was about 100 and 10 μm . We expect the “reference” microplastics can be obtained by applying the photochemical oxidation treatment.

Timeline:

March 1, 2023-

Topics:

July 7, 2024: Cite visiting at Kanazawa University
Aug. 23, 2024: Poster presentation at 2024 LRI Research Report Meeting

Publications: (only PI)

An oral presentation “Formation of parallel cracks driven by chemicrystallization and subsequent fragmentation into microplastics” was given at 11th conference of the Modification, Degradation, Stabilization of Polymers Society (MoDeSt 2024) in Sept. 1-4, 2024.