

**Title of Research:**

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## **Elucidation of the formation mechanism of microplastics**

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**Summary of Research:**

The following conclusions were obtained with using various methods to clarify the mechanisms by which secondary microplastics are formed from the viewpoint of polymer science and polymer engineering.

In the Py-APGC-MS measurement of plastics, by focusing on fragment ions characteristic of plastics and recording extracted ion chromatograms, we succeeded in extracting individual component information from plastic mixture samples of PP, PE, PVC, PS, and PET. We also succeeded in detecting PS taken up by *Daphnia magna* (adult).

As a result of comparative study of seawater degradation and photo-degradation of various plastics, it was found that the presence of seawater suppressed the progression of degradation of HDPE, PP, and PET by inhibiting the increase in sample temperature and oxygen diffusion, while the elongation at break of PA66 decreased significantly with irradiation time in seawater degradation. However, PA66 showed a significant decrease in elongation at break with irradiation time, suggesting that seawater was the main factor in the degradation.

In the case of PP, the surface of the micro-cut powder showed a brittle fracture surface and the "crack pattern" grew inside, suggesting that MP was generated from the consolidated growth of cracks, similar to the outdoor exposure. Crack patterns were also observed in the river MPs after pulverization by glass beads, but no brittle fracture surfaces were observed in most of the leaking marine MPs, suggesting that the MPs have smooth surfaces and are less prone to collapse-type weathering mechanisms.

On the other hand, the PET bottles recovered from the river retained their shape despite being left in the environment for nearly 20 years. The outer surface of the PET bottles showed no signs of becoming microplastics, although some degradation such as a decrease in molecular weight was observed.

Finally, it was confirmed that all types of plastics, including elastomers, could be miniaturized to a spherical shape of less than 1 mm in a short time by treatment with a new type of jet mill device with multiple blades arranged in an air flow channel and additional treatment with a regular jet mill. In addition, it was confirmed that the bead-mill treatment efficiently progressed the plastic refinement in a water atmosphere.

**Timeline:**

March 1, 2020 - February 28, 2021.

**Topics:**

Oral presentation at JCIA LRI Annual Workshop 2020 "Elucidation of the formation mechanism of microplastics" (On-line, August 21st, 2020)

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

1. Shinichi Kuroda, "Elucidation of the formation mechanism of microplastics," 69th Symposium on Macromolecules, September 16, 2020 (online)



2. Shinichi Kuroda, "Elucidation of the formation mechanism of microplastics," MICRO 2020, November 25, 2020 (online)