Abstract

[Research Title]

Airborne Microplastics and Health Impact

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| Cooperated by: | Tokushima University, Toyo University, Osaka Metropolitan University, Meteorological Research Institute, Hiroshima University |
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Airborne Microplastics and Health Impact

This study was the first globally to establish a comprehensive research infrastructure for the observation, analysis, environmental modeling, and health impact assessment of airborne microplastics (AMPs) through an industry-academia-government collaboration.

In Subtheme 1, several activities were carried out. First, in collaboration with PerkinElmer Japan, we established a method for quantifying airborne microplastics using micro-Fourier Transform Infrared-Attenuated Total Reflectance (μFTIR-ATR) imaging. Additionally, in partnership with domestic research institutions, we collected and identified AMPs using a unified method, elucidated their number concentration, aerodynamic and Feret diameter distribution, and deposition fluxes, and estimated inhalation amounts (in cooperation with Subsections 2 and 3). Observations of AMPs in the free troposphere, open ocean, and polar regions were conducted to assess the extent of global-scale pollution, in collaboration with Subtheme 2. Finally, we identified additives and adsorbed organic matter in AMPs and developed a quantification method for airborne nanoparticles (ANPs).

In Subtheme 2, Emission inventory of tire wear particles, one of the most abundant AMP in cities, is made. Emission, transport, photo-degradation, and deposition processes of AMPs are implemented into the Japan Meteorological Agency's regional meteorology-chemistry model NHM-Chem. An emission optimization technique is established to estimate emission inventory of AMPs from cities (population base), farmland, and ocean, by using observed concentration and deposition data in Japan and North Hemisphere obtained by Subtheme 1 and others and the NHM-Chem simulation data. By combined with IL-8 data obtained by Subtheme 3, the numerical simulation of inflammation potentials of tire wear particles and other particles originated from vehicles are estimated for the first time.

In Subtheme 3, we mainly investigated the respiratory effects of degraded PET by artificial sunlight and created transport and degraded model of PET for risk assessment. PET fibers were cut and then degraded by artificial sunlight irradiation. Exposure of mice to photo-aged PET resulted in exacerbated airway resistance. Inflammation occurred in the lungs with observed infiltration of neutrophils. Terephthalic acid

(TPA) was sustainedly released from PET aged by artificial sunlight. Exposure of mice to TPA resulted in lung inflammation and exacerbated increase in airway resistance. Collectively, these results suggest that inhalation of photo-aged PET can impact the respiratory system via TPA release.

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