Plastics Biodegradation and Plastispheres of Engineered and Natural Environments

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Background/Objectives. Plastics are the most and indispensable materials in our daily life because of their high strengths, low costs, durability, lightness, and strong resistance to environmental degradation. Common plastics such as high-density polyethylene (HDPE), low-density polyethylene (LDPE), polyethylene terephthalate (PET), polypropylene (PP), and polyurethane (PUR) account for about 65% of global production and are used in various industries. The rapid increase in production and usage has also led to rapid accumulation of plastic waste, exerting global negative impacts on environments and public health. Disposal of plastic wastes via incineration is challenging because of high costs and production of toxic pollutants. Biodegradation of plastics in the environment has been reported, but the processes are slow, and the microbes involved in the degradation remain poorly understood.

Approach/Activities. Recent studies have reported the formation of plastispheres on the plastics as biofilms of microbial communities during biodegradation of plastics. However, there is relatively little information on the microbial communities of plastispheres on different types of plastics. In this study, we examined the microbial community associated with biodegradation of five types of plastics (HDPE, LDPE, PET, PP, and PUR). The pretreated plastics were incubated microcosms containing activated sludge, landfill soils, or estuary sediments. The microcosms were incubated at room temperature for 6 months. Changes of surface characteristics of plastics before and after incubation and the microbial community and structure associated with the plastics were characterized.

Results/Lessons Learned. The plastics were biodegraded to different extents by activated sludge, landfill soils, and estuarine sediments. All HDPE, LDPE, PET, PP, and PUR showed higher degrees of biodegradation in sediments after 6 months of incubation. Plastispheres of each of the five plastics in sludge, soils, and sediments were characterized. Based on microbial community analysis, *Pseudomonas* might be responsible for degradation of various types of plastics in the sediments. Overall, our results offer the fundamental knowledge of plastispheres of these plastics in various engineered and natural environments, serving as the first step to better understand the mechanisms for biodegradation of plastics in plastispheres.