A Novel Device for in situ Removal of Microplastics From Riverbed Sediment via Laser-Induced Particle Fluorescence

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Since the invention of modern plastics during the 20th century, microplastics (MPs) have become one of the most pervasive anthropogenic pollutants on Earth—being found everywhere from the Marianas Trench, to Mount Everest, to the human brain. Very few methods have been proposed to remove these plastics from the environment in general, and up to this point no methods have been proposed to remove them from the benthic region, including sediment and the bottom of the water column—a place where they can have immense negative impacts by acting as vectors for persistent organic pollutants, by deoxygenating sediment, and by adversely affecting various biological processes. This paper thus presents the first device capable of separating these plastics within the scope of river ecosystems, and furthermore presents a first step towards creating a generalized system capable of removing any class of particle from any benthic ecosystem; a task which was previously only possible by expensive and ecologically damaging dredging. Using a simplified version of spectroscopy, the device identifies MPs by illuminating suspended particles with laser light, measuring the reflected light with a camera, then either collecting them or releasing them back into the river depending on the reflected light's wavelength and intensity. Empirical results from testing in the Milwaukee River have shown this method to remove 90.54% of microplastics which pass through the device, and with further refinement it is theorized that this performance can be further improved to become even more accurate. More broadly, this device presents the first step towards a low-cost, generalizable, and self-sufficient method of particle removal in rivers which could be broadly applied for significant ecological benefit.

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