SymbiOS: Electrostatic Capture and Enzymatic Degradation of Airborne Microplastics

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Airborne microplastics are an emerging environmental and public health concern, with recent studies suggesting that humans may inhale up to 70,000 particles daily. These polymer particulates have been detected in atmospheric aerosols, human blood, and lung tissue. This indicates widespread exposure. Despite the growing recognition of this issue, existing technologies focus primarily on passive filtration and don't eliminate the collected material. This project investigates whether integrating electrostatic particle capture with chemical depolymerization could provide a more effective, accessible, and scalable approach to mitigating airborne microplastic pollution. An electrostatic precipitation system was designed using a wire to plate configuration and optimized through theoretical modeling to ensure stable corona discharge and high particle charging efficiency. Capture performance was evaluated under controlled airflow conditions. In parallel, chemical degredation was investigated through alkaline hydrolysis, based on established protocols and using different sodium hydroxide to PET molar ratios. The electrostatic system demonstrated size dependent performance, with collection efficiencies ranging from approximately 70% for particles below 5μm to near complete for larger particles. The chemical stage is expected to achieve high depolymerization efficiency which increases as the sodium hydroxide to PET molar ratio increases. These findings support the feasibility of the two stage system that not only captures airborne microplastics but also converts them into reusable chemical components, primarily terephthalic acid. This offers a pathway toward more sustainable and scalable air remediation technologies.

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