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Recent Advances in Membrane-Based Air Filtration Technologies for Ambient Particulate Matter Separation

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Varied types of particulate matter (PM) persist in the environment and exert a harmful impact on public health. The aim of this review article is to explore the key role of membrane technology in the separation of PM from ambient air. Nanofibrous, microporous, Janus, photocatalytic and hollow fiber membranes have found significant utilization in the effective separation of PM. Recent advancements in membrane technology and their key properties such as antibacterial activity, flame retardancy, wettability, thermal stability and reusability have been underscored in this review article. Moreover, the principles of PM separation have been discussed in detail to understand the working pathway of a membrane air filter via physical, chemical or biological approaches. A brief comparison between the conventional air filters and membrane air filters is provided in terms of cost, separation principle and respective merits and demerits to understand the importance of membranes in the realm of PM separation. This study also highlighted the commercial status of PM air filters with respect to their cost and scalability. By focusing on the innovations in membrane filters, this review article has highlighted the futuristic approaches such as green fabrication techniques, highly efficient material incorporation, use of AI/ML, etc., to overcome the challenges associated with conventional air filters.

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