P3 Nanofiber Filter for Air Filtration

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Nano-aerosols 10-100 nm, in form of pollutants from combustion or viruses, are harmful to human. Due to their small sizes, they can be easily inhaled and transferred into our circulatory system causing various diseases and illnesses. Nanofibers, 80 to 300 nm in diameter, have been proven to capture effectively these ultrafine particles. This is predominantly by diffusion and interception mechanisms. However, the pressure drop can be significant. A novel patented technology has been developed by which instead of having nanofibers all stocked in a single layer coating the substrate, several layers of nanofibers, with each layer supported by a thin substrate and with the same total mass of nanofibers as a single layer, is used in the filter. This multilayer filter has been proven to reduce the total pressure drop significantly. Several examples on different materials have demonstrate the advantage on savings in pressure and power, especially for high performance filters as used in personal protection, cabin filtration and clean room.

When nanofiber filter is being used for space filter or cabin filter, over time the aerosols deposit near the upstream end of the filter forming a thin “skin” region with large pressure drop. This has been demonstrated theoretically through a new model. By stacking a microfiber filter immediately upstream of the nanofiber filter this reduces the skin effect, reduces the pressure drop, and increases the filter capacity of the system. By proper choice of the filter properties of the microfiber filter, nano-aerosols can be stored in the microfiber filter thereby making best use of the aerosol storage capacity offered by the microfiber filter. Experiments are used to illustrate the benefits of this patented dual-filter arrangement. This has great promise for cabin filtration, such as found in airplane and vehicles, and even for auditorium and hospital wards.

Both experimental and theoretical investigations have been launched to determine backpulse, backblow and combined backpulse–backblow on cleaning of a loaded nanofiber filter. Nylon 6 nanofiber filters were loaded with polydispersed NaCl particles generated from a submicron aerosol generator. Air jets in form of backpulse, backblow and their combined mode were used to clean a loaded filter. Various parameters and filter configurations have been investigated. Indeed, nanofiber filters can be cleaned by air jet for re-use, which is an added benefit for this high-performance filter media.

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