S2.1.2 Nanofibers for Air Filtration: Delivery, Durability, and Downstream Processing for ISO16890

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Nanofibers have been shown both theoretically and empirically to have the ability to provide a superior figure of merit (alpha, gamma, etc.) in air filter media over other larger fiber technologies. Nanofibers provide high specific surface area and a small, interconnected pore structure which allows a very low basis weight coating to achieve high filtration efficiencies while maintaining lowered pressure drop.

Moreover, a typical multilayer nanofiber-based composite media with a gradient structure (capacity layer/nanofiber/scrim) provides high mechanical efficiency, low pressure drop and high dust loading capacity. The upstream capacity layer comprised of synthetic fibers with a relatively large pore structure has three main functions; i) pre-filtering of large particulates, ii) preventing nanofiber layer from clogging, and iii) providing high dust holding capacity. The scrim layer located downstream of airflow protects the nanofiber layer while improving the media rigidness and providing a pleat-ability to the composite.

Filter makers need rolled stock with appropriate formatting as feedstock for matching their converting processes and downstream applications. Nanofibers can be difficult to transfer to this rolled stock and maintain performance properties useful to filtration applications due to their fragility and poor natural adhesion to common rolled good materials. Additionally, durability requirements for electrostatic discharge and pulse testing further place challenges for adoption of nanofibers in filtration applications. A third challenge for nanofibers in filtration applications is related to converting equipment necessary to form media into full filter format. Nanofibers must be able to withstand downstream processes in a filter converting operation such as winding/unwinding, lamination and pleating.

This presentation will address performance requirements for nanofiber media, material handling challenges, and test standards relevant to making nanofibers useful for filtration applications. We will take a multi-pronged approach to solving the nanofiber durability/process-ability issue by looking at 1) Substrate design, 2) Nanofiber adhesion systems, 3) Fiber to fiber bonding (cohesion), and 4) Filter build. We will combine this approach with systematically studying the effects of the aforementioned in the downstream processing/specification protocol necessary for ISO16890.