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Application of Solution-blown 20-50 nm Nanofibers in Filtration of Nanoparticles: The Efficient van der Waals Collectors[1] SUMIT SINHA-RAY, SUMAN SINHA-RAY, ALEXANDER YARIN, University of Illinois at Chicago, BEHNAM POURDEYHIMI, North Carolina State University — Filtration efficiency of commercially available filter media with fiber/pore sizes on the scale of 10 μm can be dramatically increased by adding a layer of ultrafine supersonically-blown 20-50 nm nanofibers. Different commercial filters were modified with (i) electrospun nanofibers alone, (ii) solution-blown 20-50 nm alone, and (iii) the dual coating with electrospun nanofibers deposited first and the solution-blown 20-50 nm nanofibers deposited on top of them. Detailed observations of nanoparticle removal revealed that the above-mentioned modified filters, especially those with the dual nanofiber coating with the 20-50 nm nanofibers deposited on top, are the most effective in removing the below-200 nm Cu nanoparticles/clusters from aqueous suspensions, in particular at the lowest concentrations of 0.2-0.5 ppm. The theory developed in the present work dealing with convective transport of nanoparticles in the fluid flow along with diffusion of nanoparticles and the van der Waals attraction explains and describes how the smallest solution-blown nanofibers introduce a novel physical mechanism of nanoparticle interception (the attractive van der Waals forces) and become significantly more efficient collectors compared to the larger electrospun nanofibers. The theory also elucidates the morphology of the nanoparticle clusters being accumulated at the smallest nanofiber surfaces, including the clusters growing at the windward side, or in some cases also on the leeward side of a nanofiber.

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Sumit Sinha Ray
University of Illinois at Chicago

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