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High Flux Nanofibrous Membranes for Water Purification[1]

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Recently, nanofibrous materials have been made more readily available in large part due to advances in electro-spinning and related technologies, including the use of a combination of electrostatic and gas-blowing forces. The non-woven structure has unique features, including interconnected pores, very large surface-to-volume ratio, and ease of surface modifications which enable such scaffolds to have many biomedical and industrial applications. The chemical composition of electrospun membranes can be adjusted by using different polymers, polymer blends or nanocomposites, made of organic or inorganic materials. In this talk, we demonstrate a breakthrough technology on thin-film nanocomposite membranes for high-flux water purification based on nanofiber scaffolds. The breakthrough incorporates two new and unique concepts of the membrane design: (1) the replacement of the conventional flux-limited porous substrate with a highly porous nanofibrous scaffold, and (2) the creation of a very thin, strong and functional nanocomposite barrier layer, imbedded with interconnected and directed water channels. Preliminary experiments on the hierarchical design and assembly of this unique nanofibrous membrane have already revealed very promising potentials. By using a hydrophilic nanocomposite barrier layer, an asymmetric electrospun nanofibrous mid-layer scaffold and a non-woven microfibrous support, the flux rate of this not yet optimized membrane system is 3-10 times better than that of the best among all known conventional ultrafiltration/nanofiltration media without losing the high rejection and low fouling criteria.

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