Solvent-Thermal Induced Roughening: a Novel and Versatile Method to Prepare Superhydrophobic Membranes

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Abstract: Surface roughness enhancement by fabrication of multi-scale nano/microstructure is an effective strategy to prepare superhydrophobic membranes. In this study, we report for the first time a novel **solvent-thermal induced roughening (STIR)** method to increase surface roughness on various membrane surfaces for enhanced hydrophobicity. The STIR involves the swelling of a polymer surface to create a soft shell/hard core structure under the combined action of solvent and heating, followed by a controllable surface roughening as a result of mismatched thermal expansion between the shell and the core. A polyvinylidene fluoride (PVDF) nanofibrous membrane was treated by this method. Densely-packed nanofins were formed on the nanofiber, leading to a significant increase of average roughness from 3 nm to 28 nm. The treated membrane, with an enhanced hydrophobicity (from 132.8 ° to 155.2 °) and surface area (from 7.3 to 19.0 m^2/g), showed **superior anti-wetting performance** to the low surface tension feed water than the pristine membrane in a membrane distillation process. We further demonstrate the **versatility of the STIR** method by increasing surface roughness on various forms of polymeric substrates.

The novel solvent-thermal strategy reported here opens up new directions to fabricate superhydrophobic surfaces and membranes, which can greatly benefit a wide range of applications such as membrane distillation, oil/water separation, membrane absorption and membrane catalysis.

Keywords: surface roughness enhancement, solvent-thermal treatment, superhydrophobic membrane, polyvinylidene fluoride, membrane distillation

