Hierarchical Membranes in one step

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Unlike membranes obtained by phase inversion, track etching or stretching [1], microsieves have a narrow pore size distribution, their thickness is smaller than the pore diameter and they have a flat surface. This makes their use in solid separation more efficient, because the flow resistance is low and the filter cake can be removed easily. Van Rijn firstly manufactured microsieves with the technique of photolithography.[2]

The particle-assisted wetting process developed by our work group is another possibility to produce microsieves.[3] In this technique, a monolayer of hydrophobic particles is set on a water surface and subsequently a mixture of monomer, photoinitiator and solvent is poured over. Due to capillary forces the mixture spreads between the particles and the mixture is polymerized by UV radiation. The resulting polymer film is penetrated by particles at the bottom and top side. By removing the particles, the microsieve is obtained. Because of their low thickness microsieves require a supporting layer, but transferring microsieves to the supporting layer can easily lead to cracks. That is why pore sizes of microsieves are limited to 400 nm so far. For even smaller pores, microsieve and supporting layer should be produced in one step.

To achieve this goal, modified raspberry-like particles are needed in the first place. Those consist of a bigger particle with smaller ones on its surface. When embedding those particles via particle-assisted wetting structures as shown in the picture are obtained. This can be achieved by grafting small SiO_2-particles covalently onto larger SiO_2-particles.[4] In our case the small particles (100–300 nm) functionalized with isocyanate-groups will be connected to the large particles functionalized with amino-groups (500–900 nm) forming an urea-bridge.

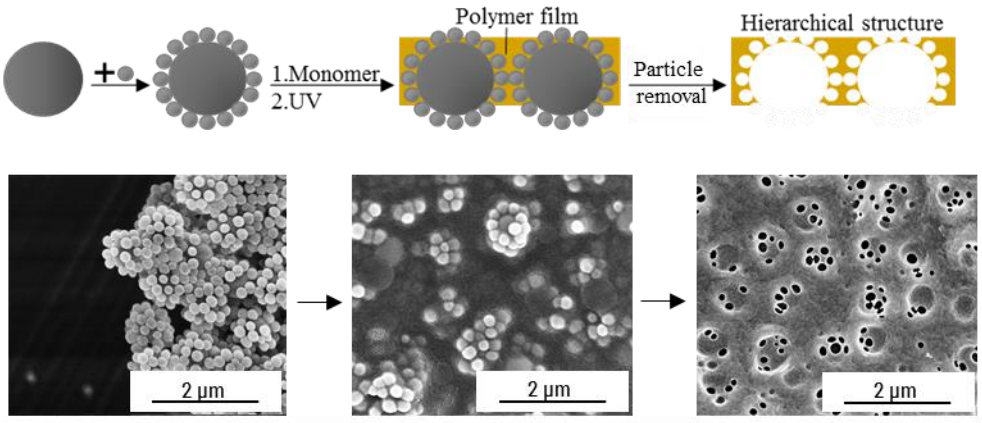

Figure 1. Scheme of hierarchical membrane production with corresponding SEM images.

[1] J. Mulder, *Basic Principles of Membrane Technology*, Springer Science & Business Media, **2012**.
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[3] H. Xu, W. A. Goedel, *Langmuir* **2003**, *19*, 2003.
[4] W. Ming, D. Wu, R. v. Benthem, G. v. With, *Nano Letters* **2005**, *5*, 2298.