

# Water Filtration with Carbon Nanomembranes

**Albert Schnieders**

Nikolaus Meyerbröker, Polina Angelova, Henning Vieker

CNM Technologies GmbH, Morgenbreede 1, 33615 Bielefeld, Germany

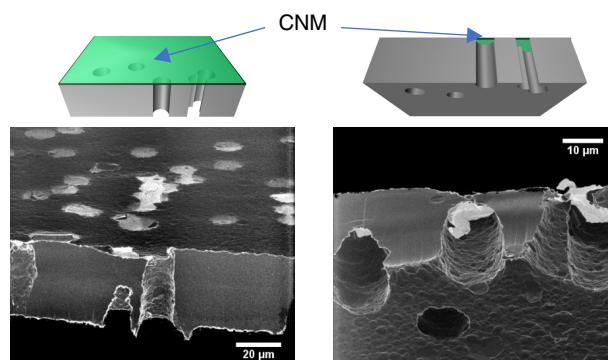
albert.schnieders@cnm-technologies.com

Carbon nanomembranes (CNMs) are a molecular-thin 2D-sheet material made by cross-linking of self-assembled monolayers of aromatic molecules. Recently scientists at Bielefeld University demonstrated that CNMs possess an extremely high pore density of one sub-nm channel per square nanometre [1]. Thus, this 2D-material combines an exceptionally high permeance (~ 800 LMH) for water with close to full rejection of salts [2] and small organic molecules like urea. We have succeeded to implement nanometre-thin CNMs as active layers in large-area composite membranes consisting of a polymer support layer with pores in the micrometre-range giving access to the free-standing active CNM-layer (Figure 1). These composite membranes are mechanically stable and can be mounted in modules. Currently, we produce sheets with areas of up to 20 x 20 cm<sup>2</sup> in the laboratory. A concept for a pre-industrial pilot production with a capacity of up to several 10.000 m<sup>2</sup> is in place. We have demonstrated in laboratory experiments applications of our composite membranes as semipermeable membranes in forward osmosis for the cold concentration of watery solutions like juices, milk, beer, wine, urine etc. (Figure 2). Another possible application is in the provision of ultrapure water, where the membrane can filter last amounts of salt, heavy metals or small organic molecules from otherwise pure water.

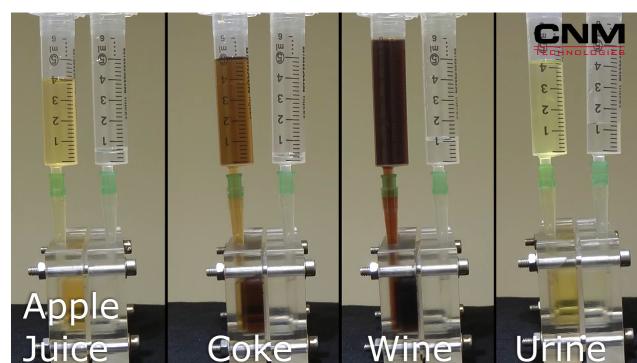
## REFERENCES

- [1] Y. Yang, P. Dementyev, N. Biere, D. Emmrich, P. Stohmann, R. Korzetz, X. Zhang, A. Beyer, S. Koch, D. Anselmetti, A. Gölzhäuser, ACS Nano 12 (2018) 4695.
- [2] Y. Yang, R. Hillmann, Y. Qi, R. Korzetz, N. Biere, D. Emmrich, M. Westphal, B. Büker, A. Hütten, A. Beyer, D. Anselmetti, A. Gölzhäuser, Advanced Materials 32 (2020) 1907850.

## FIGURES



**Figure 1:** Helium ion micrograph of a cross section of a CNM-composite membrane.



**Figure 2:** Cold concentration of watery solutions with CNM-composite membranes (for movie see <http://www.cnm-technologies.com/en/applications/membrane-technology/osmosis.html>).