doi:10.2533/chimia.2017.311 Chimia 71 (2017) 311–311

Polymer and Colloid Highlights

Division of Polymers, Colloids and Interfaces

A Division of the Swiss Chemical Society

Nanofiber-based Aerogels

T. Burger, F. Deuber, M. Merk, S. Mousavi, L. Vejsadová, and C. Adlhart*

Correspondence: Dr. C. Adlhart, Institute of Chemistry and Biotechnology, ZHAW Zurich University of Applied Sciences, Wädenswil.
E-mail: christian.adlhart@zhaw.ch

Keywords: Aerogels · Biopolymers · Electrospinning · Solid templating · Water purification

Nanofiber-based aerogels or sponges are made from preformed polymeric nanofibers.[1,2] They are very porous, ultralight and have a large internal surface as classical aerogels. But their network of interconnected fibers renders them also elastic and mechanically resilient (Fig. 1). Moreover, they show a hierarchic architecture with minor primary pores between tangled nanofibers and major cell-like pores (Fig. 1c,d). Nanofiber aerogels can be tailored to many applications due to flexibility in the choice of polymer together with the possibility to chemically modify the surface of the fibers. Possible applications include filtration, thermal insulation, support for catalysts, or scaffolds for tissue engineering.[3] Mostly, synthetic polymers such as PAN and PVA have been used as fiber materials or their blends with biopolymers such as pullulan and gelatin.[3]

The synthesis of the aerogels starting from electrospun nanofibers is straight forward and includes a freeze drying step followed by a process to stabilize the porous structure, such as chemical or thermal cross linking. The freeze drying step is also crucial for the pore structure of the aerogel and can be exploited to tailor size and structure of minor and major pores.[4] We could gradually increase the pore size between 10 and 100 μm and thereby alter gas mass transport by a factor of 7 while increasing aerosol filtration efficiency by a factor of 220.[4] This is also of interest when using these materials as catalyst support where the major pores act as the transport channels for the reactants while the minor pores provide sufficient internal surface.

At the same time, the highly porous material shows a high liquid absorption capacity of > 100 g/g. Depending on the nature of the polymer surface, the material can selectively adsorb organic solvents or impurities and could for instance be used for the purification of produced water (Fig. 2a).[5] With a polar surface instead, water is readily adsorbed and a hydrogel-like material is formed (Fig. 2b). This happens without the addition of any water-soluble polymer as in conventional hydrogels since the water (or any other fluid) is trapped in the already existing vacancies of the aerogel. This is of interest for applications such as wound dressing or tissue engineering.

Received: March 31, 2017

[1] Y. Si, J. Yu, X. Tang, J. Ge, B. Ding, *Nat. Commun.* **2014**, *5*, 5802.
[2] G. Duan, S. Jiang, V. Jérôme, J. H. Wendorff, A. Fathi, J. Uhm, V. Altstädt, M. Herling, J. Breu, R. Freitag, S. Agarwal, A. Greiner, *Adv. Funct. Mater.* **2015**, *25*, 2850.
[3] F. Deuber, C. Adlhart, *Chimia* **2017**, *71*, 236.
[4] F. Deuber, S. Mousavi, M. Hofer, C. Adlhart, *ChemistrySelect* **2016**, *1*, 5595.
[5] F. Deuber, S. Mousavi, L. Federer, C. Adlhart, *Adv. Mat. Int.* **2017**, doi:10.1002/admi.201700065.

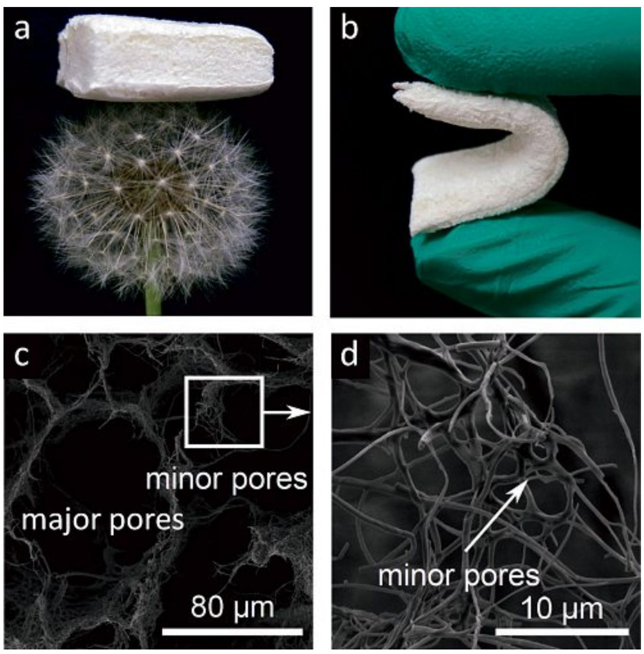

Fig. 1 a) Nanofiber-based aerogel carried by a dandelion b) aerogel twisted between fingers c) and d) hierarchic microstructure of the aerogels with major and minor pores.

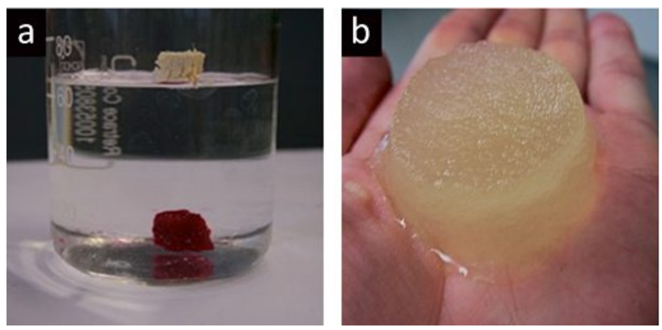

Fig. 2 a) Hydrophobic aerogel floating on water and sitting on the bottom of the beaker filled with dyed $CHCl_3$; b) hydrogel-like material.

If you are interested in submitting a new highlight, please contact:
Prof. Dr. Markus Niederberger, Department of Materials, ETH Zürich
E-mail: markus.niederberger@mat.ethz.ch, Tel.: +41 44 633 63 90