Spontaneous Water Desalination in Graphene Oxide Framework

Luca Cervini
John M. Griffin, Nathan S. Barrow
Lancaster University, Bailrigg Lane, LA1 4YB, Lancaster, UK
l.cervini@lancaster.ac.uk

For water desalination applications, carbon-based materials such as activated carbons are of interest because of their large pore volume, surface area and electric conductivity, which allows to efficiently capture ions from brackish water by applying a potential across activated carbon electrodes in a process called capacitive desalination.[1] In our previous work, we showed using Nuclear Magnetic Resonance that water is actually spontaneously partially desalinated in subnanometre pores.[2] Unfortunately, most microporous activated carbons present a variety of pore sizes, making the quantification of this spontaneous desalination for each pore size difficult.
In this work we want to achieve a material that would allow this. The material needs the following properties: large pore volume and surface area, ionophobic character as in activated carbons (coming presumably from aromatic pore walls), very narrowly distributed pore size, and finally water resistance. We therefore propose to start from graphite-like materials and expand the interlayer distance to achieve suitable pore size. Examples of similar materials can be found among Graphene-Oxide Frameworks for example[3,4], however water-resistance or ionophobicity are not guaranteed by the boronic ester and amine functional groups employed. We therefore focus our efforts on ether bonds.[5]

References

[1] M. E. Suss, S. Porada, X. Sun, P. M. Biesheuvel, J. Yoon, V. Presser, Energy Environ. Sci., 8 (2015), 2296
[2] L. Cervini, O. D. Lynes, G. R. Akien, A. Kerridge, N. S. Barrow, J. M. Griffin, Energy Storage Materials, 21 (2019), 335
[3] J. W. Burress, S. Gadipelli, J. Ford, J. M. Simmons, W. Zhou, T. Yildirim, Angew. Chem. Int. Ed., 49 (2010), 8902
[4] M. Herrera-Alonso, A. A. Abdala, M. J. McAllister, I. A. Aksay, R. K. Prud'homme, Langmuir, 23 (2017), 10644
[5] I. A. Vacchi, J. Raya, A. Bianco, C. Ménard-Moyon, 2D Mater., 5 (2018), 035037

Figures

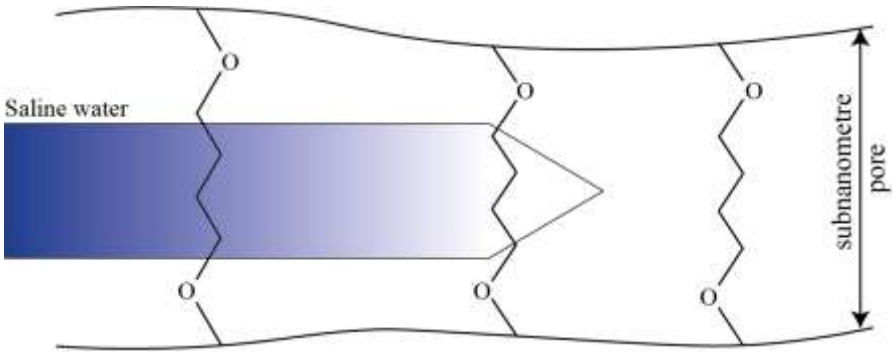

Figure 1: Spontaneous water desalination in ether-based graphene-oxide framework with well-defined subnanometre pores.