Structural characterization of aerogels centered on application

József Kalmár[a], Attila Forgács[a], Adél Len[c], Zoltán Dudás[c], István Fábián[a]

[1]*Department of Inorganic and Analytical Chemistry, University of Debrecen, Egyetem tér 1, Debrecen, H-4032 Hungary*

[2]*Neutron Spectroscopy Department, Centre of Energy Research Center, Konkoly-Thege Miklós út 29-33, Budapest H-1121, Hungary*

**Correspondence: kalmar.jozsef@science.unideb.hu*

When aerogels are designed to be used in aqueous media, e.g. in biomedical or environmental engineering applications, it is essential to understand the mechanism of the hydration of the backbone and the consequent modification of the aerogel structure. The most important questions are the following. 1) Does the extensive hydration of the backbone cause the erosion of the aerogel monolith? 2) What is the stable particle size and surface charge of the hydrated aerogel? 3) Is the microscopic morphology of the aerogel the same in the dry and in the hydrated states? 4) Are the pores of the aerogel permeable in water, or does the porous structure collapse due to the extensive deformation of the hydrated backbone? Evidently, the answers to these questions are indispensable for understanding the properties of hydrated aerogels related to mass transport, adsorption-desorption phenomena, suspension stability and biocompatibility.

For the investigation of the hydration mechanisms and the hydration induced structural changes of different types of aerogels; NMR spectroscopy (diffusiometry, relaxometry, cryo-porometry) and small angle neutron scattering (SANS) techniques can conveniently be utilized.

Examples for fundamentally different hydration mechanisms are given in the case of silica-gelatin and silica-casein hybrid aerogels. [1-4] An example is also given for polysaccharide aerogels, as fundamental structural changes take place during the hydration of the archetypical Ca(II)-alginate aerogel. [5]

Acknowledgements:

This research has been financially supported by the National Research, Development and Innovation Office, Hungarian Science Foundation (OTKA: FK_17-124571). J. Kalmár is grateful for the János Bolyai Research Scholarship of the Hungarian Academy of Sciences.

References:

1. P. Veres, et.al. *Colloids Surf. B* **152**, 229-237. (2017)
2. M. Kéri, et.al. *Acta Biomater.* **105**, 131-145. (2020)
3. I. Lázár, et.al. *Appl. Surf. Sci.* **531**, 147232. (2020)
4. P. Herman, et.al. *ACS Appl. Nano Mat.* **3**, 195-206. (2020)
5. A. Forgács, et.al. *ACS Appl. Mater. Interfaces* **13**(2), 2997-3010. (2021)