Influence of particle size on surface water interactions of zeolite

Glorija Medak Spahić [a], Marko Dunatov [a], Jan Marčec [b], Josip Bronić [a], Andreas Puškarić [a], Lidija Androš Dubraja [a]

[a] LSNM, Division of Materials Chemistry, Ruđer Bošković Institute, Bijenička cesta 54, Zagreb, Croatia
[b] Department of Inorganic Chemistry and Technology, National Institute of Chemistry, Hajdrihova 19, SI-1001 Ljubljana, Slovenia

gmedak@irb.hr

Zeolites are inorganic crystalline materials most often composed of SiO4 and AlO4 corner-sharing tetrahedral units that create a negatively charged framework, whose charge is compensated by the presence of Mn+ cations (M = NH4+, Na+, K+, Ca2+, etc.). Although their use in gas separation and petroleum refining has become indispensable, there are still many other applications that can benefit from their properties, such as high thermal stability and low production cost. The use of zeolites for potential electronic applications is a field that is slowly gaining more attention. However, to develop a material for an electronic application, it is necessary to first understand its conductivity properties. The conductivity of zeolites is largely influenced by its intercations with guest molecules, most often water. Moreover, water is not only located on the surface of zeolite particles, but it also creates hydrogen-bonded clusters inside the zeolite channels. To distinguish how differnt interaction between water molecules and zeolite affect its overall conductivity, two FAU type zeolites of similar composition but different particle size were chosen; nanoparticles (n-FAU, crytsalite size under 100 nm) and microsized particles (μ-FAU, average size 3 μm). Conductivity measurements were performed at different relative humidity conditions (vacuum, 60, 75 and 100% RH) and at different temperatures in order to calculate activation energy, while interactions of material with water molecules were studied using differential scanning calorimetry (DSC), thermogravimetric analysis (TG), and powder X-ray diffraction (PXRD). Particle surface defects were investigated using Fourier-transformed infrared spectroscopy (FTIR) in vacuum using deterated acetonitrile as a probe molecule.

Keywords:
Zeolite, proton conductivity, water-material interactions,

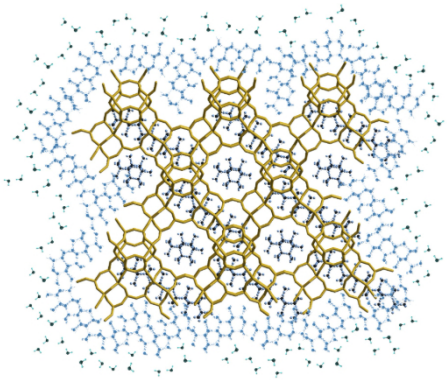

Figure 1. Schematic representation of water molecules interacting with the zeolite framework

References:

[1] Glorija Medak Spahić, Marko Dunatov, Jan Marčec, Josip Bronić, Andreas Puškarić, Lidija Androš Dubraja, *J. Mater. Chem. A* , 2026, DOI: 10.1039/D5TA10130A

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