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Dynamics of water inside boehmite suspensions probed by NMR techniques

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γ -Alumina is a widely used heterogeneous catalytic support. To perfect the optimization of its catalytic performance, the accessibility of the molecules to active sites and more generally the molecular transport inside the support need to be fully assessed. As γ -alumina is obtained through a topotactic transformation, most of its properties are inherited by the boehmite and its process [1]. The peptization, where the agglomerates of the raw boehmite powder break into aggregates and then reorganize themselves, is one of the key steps for the final structure and properties of the support.

In this work, we perform a multi-scale analysis of the water dynamics inside boehmite suspensions. Diffusion is assessed on a second-to-millisecond time scale by PFG-NMR while confined dynamics at the interface and particularly bulk mediated surface diffusion is probed by Fast-Field Cycling NMR (NMRD) on a microsecond time scale. We especially study the influence of the aggregates organization on the solvent dynamics. To this aim, several boehmite suspensions have been prepared by varying the ionic force and the volume fraction of boehmite. Whether it arises from the topological structure or the strong interactions to the surface, the water dynamics appears to undergo confinement effects. For instance, at the microsecond time scale, the prepared boehmite suspensions display almost identical NMRD profiles. It means that the long-range geometry of the system does not seem to influence the dynamics. Furthermore, we were able to prove that the observed water dynamics comes from a confined area: the adsorption layer (first few water monolayers from the surface). At this scale, the water dynamics seem to be controlled only through strong interactions with the surface of aggregates. Hence, we found that surface diffusion of water in boehmite is slow. QENS experiments could bring a deeper understanding of this surface diffusion.

[1] H. Degisch, B. Kriszt, Wiley-VCH, 3, (2002), 1591- 1668

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