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Pseudo-restricted self-diffusion of molecules in biporous structures: Study by pulsed field gradient NMR

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Abstract

The mobility of liquid (n-decane) that fills the system of primary and secondary pores of a biporous sample (granular Vycor porous glass) is studied by the pulsed field gradient NMR technique. The anomalous time dependence of the slow component of diffusion decay is revealed: the self-diffusion coefficient decreases with an increase in diffusion time t_d and, at large t_d values, this dependence satisfies the feature of completely restricted self-diffusion. It is established that this component is related to the mobility of liquid molecules filling the system of primary pores. By use of computer simulation, it is shown that the effect of "pseudo-restricted" diffusion is explained by the exchange processes between the phases, where the molecules of the liquid that are present in the systems of primary and secondary pores and differ in self-diffusion coefficients are understood as the phases. The effect of interfacial exchange is confirmed by the time dependence of the fraction of molecules with the lowest self-diffusion coefficients. The revealed phenomenon of "pseudo-restricted" diffusion is not related to real spatial constraints and can be observed in any systems with two (or more) phases with different self-diffusion coefficients, provided that these "phases" are bulky and can be subjected to molecular exchange. © 2005 Pleiades Publishing, Inc.

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