Combination of Time-Dependent Self-Diffusion Measurements (Dynamic Imaging) with Magnetic Resonance Imaging.

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Abstract

To characterize the pore space of porous media, observation time-dependent self-diffusion measurements are of particular interest. The determination of the ratio of inner surface-area to pore volume S/V_p and the tortuosity T of porous media is possible applying these methods, which are summarized under the term “Dynamic Imaging” (DI). Parameters as the permeability or an average particle diameter can be calculated. To obtain the time-dependent self-diffusion coefficients, usually the pulsed field gradient (PFG)-NMR technique is used. It gives volumetrically averaged properties of the porous matrix and operates at length scales between a few hundreds of nanometers up to several hundreds of micrometers.
On the other hand, magnetic resonance imaging (MRI) is a well-known technique to obtain spatially resolved spin-density maps also of optically non-transparent objects. The spatial resolution of MRI is in the range of several tens of micrometers up to several millimeters.
In this paper we will present a new approach where we combine the two well-known methods in order to enhance the possibilities of both methods.
With the combination mentioned before *local* structural and dynamic information of porous media with heterogeneities in the millimeter scale are obtainable. In given areas, spatially resolved by MRI, dynamic imaging with a higher spatial resolution than MRI can be applied to get the *local* structural and dynamic information.
Thus, in heterogeneous systems the structural parameters mentioned above can be obtained e.g. as a function of a spatial axis along the sample. The new possibilities of the combined MRI/DI application are demonstrated on a porous model system consisting of differently sized glass beads beds, gel and water.