

Short-time diffusion behavior of Brownian particles in porous solids

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Abstract

© Kazan Federal University (KFU). The process of self-diffusion of particles confined to porous solids is studied for time intervals corresponding to particle displacements shorter than the characteristic pore size. The solid matrix is modeled as a (random) potential field with an infinitely large potential within the solid which decays to zero at distances of the order of a few particle sizes from the pore walls. Diffusion of particles in the thus created potential field is described by the Smoluchowski diffusion equation. It is shown that, for short diffusion times, the resulting equation for the time-dependent diffusivity reproduces that earlier obtained in the literature [Mitra et al., Phys. Rev. Lett. 68, 3555 (1992)], but with the numerical constant differing by factor 2. The conditions under which this discrepancy arises are highlighted and discussed.

Keywords

Diffusion, Porous solids, Short-time expansion, Smoluchowski equation