Diffusion and Transport of Substances: Basic Descriptions and Examples

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Abstract

Diffusion and transport of substances are physicochemical phenomena of an extremely broad occurrence. The question can be broad forward: are systems existing without diffusion and without a mass transport? Systems, which are in equilibrium, reveal under microscopic observation a statistical movement of small dust or seed particles (Brown's movement, 1827) without a mass transport in a macroscopically sense. The theoretical explanation of these movements was brought into the relation with the kinetic theory of heat, however, a direct quantification with the velocity of the particles was impossible for many years. Einstein and Smoluchowski found the possible rational for an experimental approach. The mean square of displacement of these particles for a given time interval is caused by the resulting force from their interactions with the non-observable molecules of the liquid or the gaseous phase (Annalen der Physik 1906). The statistical movements of the molecules explain the basic element of diffusion with a mean for the kinetic energy of $3/2 \bullet kT$.
The basic laws for the diffusion shall be outlined for one phase systems and also for multiphase systems.
Examples for basic types of membranes and specific diffusion and transport systems will be outlined.

References

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