Mass Diffusion and Thermodiffusion in Multicomponent Fluid Mixtures

Jan Sengers[1, S, C]

[1]*Institute for Physical Science and Technology, University of Maryland, College Park, MD, U.S.A.*
sengers@umd.edu

While the subject of mass diffusion and thermodiffusion in binary fluid mixtures is well understood, the issues regarding mass diffusion and thermodiffusion in multicomponent fluid mixtures are more complex. In contrast to mass diffusion coefficients and thermodiffusion coefficients of binary fluid mixtures, mass diffusion coefficients and thermodiffusion coefficients of multicomponent fluid mixtures depend on the representation used to specify the composition of the mixtures, i.e., whether mass fractions, mole fractions, or volume fractions are used. This problem causes considerable complexity comparing and using experimental diffusion coefficients reported by different authors, even for the same mixtures. This paper will show how one can redefine mass diffusion and thermodiffusion coefficients of multicomponent fluid mixtures, so that they become independent of the frame of reference by applying a simple transformation to the Fick's law and thermodiffusion relations in terms of matrices that only depend on the known composition of the mixtures. Solution of this problem has become pertinent, since more and more experimental diffusion data, at least for ternary mixtures, are currently becoming available. Reporting diffusion data in terms of these frame-independent mass diffusion and thermodiffusion coefficients would greatly facilitate use of experimental diffusion data for practical applications.

References:

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