RESEARCH PAPERS

关于正常扩散Stefan-Maxwell 公式和 Grahan 扩散定律的注记

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收稿日期　修回日期　网络版发布日期　接受日期

摘要　Certain prerequisite information on the component fluxes is necessary for solution of the
Stefan-Maxwell equation in multicomponent diffusion systems and the Graham's law of diffusion and effusion is often resorted for this purpose. This article addresses solution of the Stefan-Maxwell equation in binary gas systems and explores the necessary conditions for definite solution of concentration profiles and pertinent component fluxes. It is found that there are multiple solutions for component fluxes in contradiction to what specified by the Graham's law of diffusion. The theorem of minimum entropy production in the non-equilibrium thermodynamics is believed instructive in determining the stable steady state solution out of infinite multiple solutions possible under the specified conditions. It is suggested that only when the boundary condition of component concentration is symmetrical in an isothermal binary system, the counter-diffusion becomes equimolar. The Graham's law of diffusion seems not generally valid for the case of isothermal ordinary diffusion.

关键词　ordinary diffusion　Stefan-Maxwell equation　Graham's law of diffusion　theorem of minimum
entropy production　nonequilibrium thermodynamics

分类号

DOI:

Notes on Stefan-Maxwell Equation versus Grahan's Diffusion Law

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Abstract Certain prerequisite information on the component fluxes is necessary for solution of the Stefan-Maxwell equation in multicomponent diffusion systems and the Graham's law of diffusion and effusion is often resorted for this purpose. This article addresses solution of the Stefan-Maxwell equation in binary gas systems and explores the necessary conditions for definite solution of concentration profiles and pertinent component fluxes. It is found that there are multiple solutions for component fluxes in contradiction to what specified by the Graham's law of diffusion. The theorem of minimum entropy production in the non-equilibrium thermodynamics is believed instructive in determining the stable steady state solution out of infinite multiple solutions possible under the specified conditions. It is suggested that only when the boundary condition of component concentration is symmetrical in an isothermal binary system, the counter-diffusion becomes equimolar. The Graham's law of diffusion seems not generally valid for the case of isothermal ordinary diffusion.

Key words ordinary diffusion; Stefan-Maxwell equation; Graham's law of diffusion; theorem of minimum entropy production; nonequilibrium thermodynamics

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