

Concentration Shock Waves Generated by Thermal Diffusion

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The Ludwig-Soret effect, also known as thermal diffusion, refers to the separation of chemical species in a thermal gradient. Solution of the nonlinear partial differential equation that describes thermal diffusion in a binary mixture shows that sharp, moving concentration gradients, analogous to the ordinary shock waves described by fluid dynamics, are produced. A mathematical relation for concentration shocks analogous to the well-known Rankine-Hugoniot relations that describe fluid shocks is derived. Self-diffraction experiments show a large number of diffracted light beams are generated, corresponding to the presence of high spatial harmonics of concentration in suspensions of particulates having large Soret coefficients. Experiments where concentration profiles are recorded directly with a ccd camera attached to a microscope are reported.