Diffusion and Soret Effect in Ternary Mixtures

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In mixtures, subjected to a temperature gradient at a constant pressure, the diffusive transport is caused not only by gradients of concentrations but also by gradients of temperature. The mass flow induced by a temperature gradient in mixtures is referred to as the Soret effect (thermodiffusion or thermal diffusion). Nowadays, the Soret effect of almost any binary fluid can successfully be studied under laboratory conditions. The investigation of ternary liquid mixtures is significantly more complex than the binary case and has made progress only during recent years. While binary mixtures are fully characterized by one diffusion and one thermodiffusion coefficient, there are six independent parameters in the ternary case: four diffusion coefficients and two thermodiffusion coefficients. The necessity of resolving two independent concentrations requires two different and independent diagnostics. For this purpose, traditional optical techniques with two laser diodes emitting different wavelengths may provide six independent coefficients. The first experiments have shown that in addition to the experimental difficulties, there are mathematical problems of coefficients extraction from the measured signals. One of the most serious limitations is a property of matrix of the so-called optical contrast factors; i.e; the matrix with elements composed by the derivatives of refractive indices with respect to concentrations. The matrix can be ill-conditioned, and the error in the retrieved concentrations becomes dramatic, preventing accurate measurements. Another problem is resolving of the diffusion matrix. Its seems that only eigen values of the diffusion matrix can be retrieved accurately from thermodiffusion experiment but not the elements.