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Experimental measurements of diffusion coefficients for multi-component hydrocarbon mixtures from ground base laboratory to the international space station

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A spatial concentration or chemical potential difference within a solution or mixture is the most common driving force for mass diffusion. In a homogeneous solution, temperature or pressure gradients may also cause mass diffusion. The former process is called thermal diffusion (thermodiffusion) or Soret effect discovered by Ludwig and established by Soret. Thermal diffusion is a coupled heat and mass transfer phenomenon. Although the thermal diffusion coefficient may be several orders of magnitude smaller than the molecular mass diffusion coefficient, it plays an important role in processes, such as the compositional variation in hydrocarbon reservoirs, isotropic separation of liquids, and emerging applications, such as particle manipulation by temperature gradient also known as thermophoresis for microfluidic applications, and optical screening methods for biomolecules and colloids. Due to smallness of the thermal diffusion coefficient and the possibility of coupling thermal diffusion with other ways of mass transfer such as convection, accurate and reliable measurements are difficult to perform under practical conditions. Therefore, development of theoretical models for prediction of thermal diffusion parameters is of great importance for design and control of pertinent processes and systems. Due to the complex nature of thermal diffusion phenomenon, several approaches have been employed to model this process, among which the kinetic theory and non-equilibrium thermodynamics and their combinations are the most accepted. Experiment was conducted on board FOTON M3 unmanned satellite followed by two experiments on board the International Space Station to measure the diffusion coefficients. A detailed explanation of the experiment performed on board FOTON M3 satellite and onboard the International Space Station experiments will be presented. Lesson learned and future mission to Space will be highlighted.

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