

Thermodynamics of Crystals in Solution

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Abstract: Industrial crystallization from solution is a vital process in many industries including those involving minerals processing, petrochemicals, food products, consumer products, agricultural chemicals and pharmaceuticals, among others. The solubility of different solid species in a solution is vital information for the design of industrial crystallization units. The range of species involved is very wide, and the types of solid phases present in industrial process is also numerous, however a thermodynamic understanding of all potential systems can be achieved with a relatively small range of thermodynamic theory.

This short course presents an overview of the phase equilibria of crystals in solution including measurement techniques, types of phase diagram and thermodynamic modeling of solid-liquid phase equilibrium. The types of crystalline species considered will include free molecules, hydrates and solvates, cocrystals, salt forms, adducts such as clathrates, and solid solutions. Other characteristic thermodynamic properties of solid-liquid systems such as freezing point depression will also be covered. The course will focus on accurate thermodynamic models including analysis of both ideal and non-ideal systems.

Keywords: Crystallization; Phase equilibrium; Solid-liquid equilibrium, Thermodynamic models