

**PROBLEMS OF THERMODYNAMIC ANALYSIS OF EUTECTIC SYSTEMS**

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Thermodynamic analysis of phase diagrams of eutectic systems is a classical physico-chemical task that is not problematic. Indeed, the vast experimental material accumulated to date, mainly on inorganic binary and multicomponent eutectic systems, is already textbook: the corresponding diagrams are indispensable illustrations in textbooks on physico-chemical analysis. In recent years, the word "eutectic" has been most often found in the context of the concept of so-called deep eutectic solvents (DES), whose components are mainly organic compounds. Thermodynamic analysis of the phase diagrams and properties of these systems revealed a number of problems that were not so significant in the case of "ordinary" inorganic eutectic.

Although the works devoted to DES occupy a significant place in the modern scientific literature, the analysis of publications shows that the meaning of the term DES is becoming more vague and uncertain and does not fully correspond to the traditional statements of physico-chemical analysis, but is associated with the characteristics of intermolecular interactions (donors and acceptors of hydrogen bonds), which cannot be considered a unique feature of DES. One of the obvious gaps in publications is, for example, the frequent lack of data on solid phases necessary to present diagrams of eutectic systems.

In our opinion, the wide temperature range in the case of real DES does not allow direct application of traditional thermodynamic approaches, in particular, the Schroeder – Van Laar equation, including its modifications. The presentation examines these and other issues of common fundamental interest. In particular, what interactions in solid phases lead to the melting of a heterogeneous mixture of eutectic composition, including those formed by crystals of pure components (simple eutectic), at temperatures significantly different from the melting temperature of pure substances. Related to this are such problems as: a) what factors determine the "depth", that is, the relatively low melting point of eutectic, b) how the atomic-molecular structure of DES components and their interaction determines their macroscopic thermodynamic properties calculated at the atomic level. It is also advisable to take into account the difference between "organic" eutectics and "inorganic", which manifests itself not only in the structures of solid solutions (when they are formed as molecular crystals), but also in the formation of other forms, in particular, co-crystals. In this regard, the report also provides some results of our research and possible approaches to analyzing DES state diagrams based on data from molecular dynamics and quantum chemistry.

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