



Editorial

Special Issue on Deep Eutectic Solvents: A foreword



Is a Special Issue on Deep Eutectic Solvents (DES) in Fluid Phase Equilibria necessary and justifiable? This was the first question we asked ourselves when we were approached by the Editors of the journal. A Special Issue on DES would not be needed if it was just another collection of articles or reviews on DES and their applications; there is a surplus of literature on the subject already. However the glut of literature on DES applications in all fields has not been followed by a similar effort aimed at understanding the nature of these novel solvents, and how to describe and model them. It was the need to fulfill this gap that lead us to compile this Special Issue on DES.

There is often the wrong idea that technology is generally developed upon the foundations of science and knowledge; the opposite is often the case. This is particularly true in a science like thermodynamics, which was developed during the 19th century to understand and optimize the steam engine. The same seems to be happening today with DES. For ionic liquids, a fundamental understanding of what was unique in their liquid phase structure was developed alongside novel applications; however, with DES there has been rapid progress focused almost exclusively on the novel applications of these solvents and has not been followed by an sufficient effort to address the fundamental understanding of their nature. Such knowledge is essential for the efficient design and selection of the best DES for a given application and to model properties and phase equilibria, without which the process design is impractical.

A Special Issue on DES in Fluid Phase Equilibria could only be significant if one of its main goals was to further deepen their understanding, namely their interactions and phase equilibria, and to help question and correct some widespread misconceptions, hopefully contributing to establish a correct definition of what a DES is. DES are not, and should be not treated as low cost and easy to prepare ersatz ILs, as they do not have the properties of ILs. They are not a novel compound or a new type of compound, they are just binary or ternary mixtures, and it is as mixtures that they should be treated and not as pseudo pure compounds. The use of names for these mixtures, such as reline, ethaline, glyceline etc, should be avoided because they do not express the diversity of

mixtures that hides behind that name, and creates the false sensation that one is dealing with a new pure compound and not a mixture.

The presence of a eutectic point in a mixture cannot be used to define or characterize a DES since essentially all mixtures of compounds immiscible in the solid phase will present an eutectic point. Neither the formation of hydrogen bonds between two components of a mixture can be used to define or characterize a DES, since this would describe any ideal mixture of fatty acids or fatty alcohols. Should any solution of cholinium chloride, or any other solid hydrogen bond acceptor, in a protic solvent be considered a DES? Can we call an aqueous solution of NaCl or a sugar a DES? Why then consider a DES a solution of cholinium chloride in ethylene glycol or glycerol? A stricter definition of a DES is urgent. An understanding of what is the nature of a DES that makes it different from any conventional eutectic mixture or solution is mandatory. It is in this call to action that this Special Issue on DES intends to be. The community of thermodynamicists, which is particularly well positioned to understand this problem, can and should come up with answers contributing to a better comprehension of the nature of these mixtures, and what makes them so suitable for many applications.

We do not pretend to have reached any answers with this Special Issue, but only to help formulate some of the questions and stimulate healthy and fruitful discussion between the reviewers and the authors and the authors and the journal readers. We must thank all the authors that have accepted to participate in this Special Issue for contributing with their knowledge, work and efforts for its success. The variety of approaches, from fundamental to applications, will become, we hope, a sound stepping stone for further developments in this field.

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