

Ecole Doctorale des Sciences Fondamentales

Title of the thesis:

Characterization and Design of new deep eutectic solvents

Supervisor : Pascale HUSSON

Laboratory : Institut de Chimie de Clermont-Ferrand

University : Université Clermont Auvergne

Email and Phone : pascale.husson@uca.fr, + 33473407193

Possible co-supervisor : Jean-Michel ANDANSON

Laboratory : Institut de Chimie de Clermont-Ferrand

University : CNRS/Université Clermont Auvergne

Summary :

The term 'deep eutectic solvent' refers to a mixture of two components with a melting point far below the melting points of the pure components. The large decrease of the melting point is explained by strong interactions (via H-bonds) between the two compounds. Practically, it means it is possible to obtain a liquid, at temperature close to ambient with two solids. (1) Some of these new solvents are easy to prepare, cheap, non-toxic and biodegradable which makes these systems especially promising for green chemistry. Possible applications of this new class of solvents in catalysis, biomass pre-treatment, electrodeposition/electropolishing of metals and nanoparticles synthesis have already been demonstrated. (2) A lot of H-bond donors/acceptors can form eutectic solvents. To be able to select the most adequate couple for a given application, physico chemical understanding of these complex systems is necessary but still missing.

A study was published by our group on the impact of water on the properties of urea-choline chloride system. (3) The lack of physico chemical characterisation was stressed in this work. The main objective of this project will be to relate the macroscopic properties of the eutectic mixture to its molecular structure. At macroscopic level, the solid-liquid phase diagrams will be established and relevant properties (in particular transport properties) will be measured. Then an accurate description of the particular structure and interactions that are responsible of this unique state will be obtained using spectroscopy.

During this work, different types of systems will be investigated: first, simple molecules in order to provide insights into these mixtures, then, more complex systems, adapted for specific applications in synthesis or separations. As these mixtures are promising as green

¹ Chem. Comm., 2003, 70-71

² Chem. Soc. Rev., 2012, 41, 7108-7146.

³ New Journal of Chemistry, 2016, 40, 4492-4499.

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media, we will also focus on eutectic solvents involving biosourced and biodegradable molecules.

Qualifications: A Master in chemistry is necessary. The highly motivated student will have the opportunity to apply a variety of physico chemical techniques (phase equilibrium, calorimetry, viscometry, IR and NMR spectroscopies).