



Ongoing work - Deep Eutectic Systems as an Alternative to Solvents in Painting Conservation

Natural deep eutectic solvents (NADESs) are considered as green solvents, and due to their promising sustainability, they have been applied in many research fields. In this study, the main goal is to use various NADES systems to replace the traditional solvents used in conservation and restoration to remove varnish layers in a painting. The toxicity of traditional solvents, such as toluene or acetone, is well known in the chemistry field. To replace them, it is important to understand the intrinsic physicochemical properties of a solvent that may act as a substitute. Polarity and solubility are proposed as the best parameters required for this study.

The Nile red probe was used to confirm the similarity between the polarity of deep eutectic systems (DESs) and traditional solvents. According to their polarities and Hansen solubility parameters, it is possible to predict the best solvents to solubilize the natural resin varnishes. Besides this, some arithmetic models can also be applied to estimate the critical or thermodynamic properties, which are useful tools to predict the behavior of these solvents. The researchers have further proven the possibility of dissolving natural varnishes such as dammar or mastic in hydrophobic DESs, such as menthol + lauric acid, menthol + decanoic acid, or menthol + thymol.



Evaluation of Deep Eutectic Systems as an Alternative to Solvents in Painting Conservation. Cláudio Correia Fernandes, Reza Haghbakhsh, Raquel Marques, Alexandre Paiva, Leslie Carlyle, and Ana Rita Cruz Duarte. *ACS Sustainable Chem. Eng.* 2021, 9, 46, 15451–15460



CryoDES in the final of HiTech program

The HiTech program has been developed with the aim of training scientists who have innovative ideas for the business world. In the 2021's edition, 8 projects reached the final of the program, trying to win a place in the commercial circuit. One of these projects is CryoDES, developed by the DES.Solve team members Ana Rita Duarte, Alexandre Paiva, Marta Marques and Ana Rita Gameiro. The concept refers to a cryoprotective agent that promises to guarantee the cryopreservation of cells at -20°C , instead of the -196°C required by current technologies. In addition to reducing the ecological footprint, the new liquid cryoprotectant could help reduce the use of toxic elements.

Participation in conferences

- IMRC 2021 - XXIX International Materials Research Congress
- ESAT 2021 - 31st European Symposium on Applied Thermodynamics
- IC3TC 2021 - 4th International Caparica Christmas Conference on Translational Chemistry

Publications

- "Deep eutectic systems from betaine and polyols – Physicochemical and toxicological properties" - *Journal of Molecular Liquids*
- "Unveiling the potential of betaine/polyol-based deep eutectic systems for the recovery of bioactive protein derivative-rich extracts from sardine processing residues" - *Separation and Purification Technology*
- "Therapeutic Liquid Formulations Based on Low Transition Temperature Mixtures for the Incorporation of Anti-Inflammatory Drugs" – *Pharmaceutics*
- "Evaluation of Deep Eutectic Systems as an Alternative to Solvents in Painting Conservation" – *ACS Sustainable Chemistry & Engineering*
- "Density of Deep Eutectic Solvents: The Path Forward Cheminformatics-Driven Reliable Predictions for Mixtures" – *Molecules*
- "Viscosity Investigations on the Binary Systems of (1 ChCl:2 Ethylene Glycol) DES and Methanol or Ethanol " – *Molecules*
- "Volumetric investigation of aqueous mixtures of the {choline chloride + phenol (1:4)} deep eutectic solvent" - *The Journal of Chemical Thermodynamics*
- "Influence of natural deep eutectic systems in water thermal behavior and their applications in cryopreservation" - *Journal of Molecular Liquids*

DES Solve welcomes STSM researchers

On the scope of the COST Action Greenering, DES Solve research group has received some foreigner researchers, namely the post-doctoral fellows Manuela Panic, coming from the Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia, and Andromachi Tzani, coming from National Technical University of Athens, Greece. Manuela spent four weeks with DES Solve, learning new techniques on *in vitro* assessment of THEDES, while Andromachi was



working on the bioactivity of olive leave extracts on different NADES. During Short Term Scientific Missions (STSMs), DES Solve follows all safety pandemic measures.

<https://greenering.eu/>