

SUPRADES: New supramolecular systems combining properties of DES and macrocyclic hosts

Sophie Fourmentin

Université du Littoral-Côte d'Opale (ULCO), Unité de Chimie Environnementale et Interactions sur le Vivant (UCEIV, UR 4492), SFR Condorcet FR CNRS 3417, 145, Avenue Maurice Schumann, MREI 1, 59140 Dunkerque, France

lamotte@univ-littoral.fr

Deep eutectic solvents (DESs) are a new generation of green solvents reported for the first time in 2003¹. The term DES is commonly used to describe low melting point liquids formed by combining hydrogen bond acceptor (HBA), generally an organic salt, and hydrogen bond donor (HBD) components. DES composed of non-ionic species were lately described².

Cyclodextrins (CDs) are a well-known family of cyclic oligosaccharides able to form inclusion complexes in aqueous solution with a wide range of molecules of low hydrophilicity and suitable geometrical size through noncovalent host-guest interactions³. Hence, CDs can find applications in numerous domains like pharmaceuticals, cosmetics, food, catalysis or environmental protection.

We recently investigated mixtures of DESs and CDs as they may result in novel hybrid materials that combine and mutually reinforce the beneficial properties of the individual components. We were able to solubilize various CDs in the DES based on choline chloride:urea (1:2) and demonstrated that inclusion properties of CDs were maintained in this DES⁴⁻⁶. Moreover, the solubility of native CDs in choline chloride:urea was significantly enhanced if compared to water⁷. Additionally, low melting mixtures (LMM) were obtained by mixing CD derivatives and various hydrogen bond donors^{8,9}. CDs also retained their inclusion ability in the resulting media. The obtained binary and ternary supramolecular systems combine effectively the properties of DESs and CDs leading to a new promising class of hybrid materials that we called SUPRADES. These systems were evaluated for the solubilization of volatile and bioactive compounds. The impact of progressive addition of water was also investigated^{6,9}.

To this date, few examples of inclusion complexes formation were reported in non-aqueous media and this finding can open up the way to new, hitherto unpredictable applications.



Binary and ternary supramolecular systems

References

- 1 A. P. Abbott, G. Capper, D. L. Davies, R. K. Rasheed and V. Tambyrajah, *Chem. Commun.*, 2003, 70–71.
- 2 D. O. Abranches, M. A. R. Martins, L. P. Silva, N. Schaeffer, S. P. Pinho and J. A. P. Coutinho, *Chem. Commun.*, 2019, **55**, 10253–10256.
- 3 G. Crini, S. Fourmentin, É. Fenyvesi, G. Torri, M. Fourmentin and N. Morin-Crini, *Environ. Chem. Lett.*, 2018, **16**, 1361–1375.
- 4 T. Moufawad, L. Moura, M. Ferreira, H. Bricout, S. Tilloy, E. Monflier, M. C. Gomes, D. Landy and S. Fourmentin, *ACS Sustain. Chem. Eng.*, 2019, **7**, 6345–6351.
- 5 M. E. Di Pietro, G. Colombo Dugoni, M. Ferro, A. Mannu, F. Castiglione, M. Costa Gomes, S. Fourmentin and A. Mele, *ACS Sustain. Chem. Eng.*, 2019, **7**, 17397–17405.
- 6 G. Colombo Dugoni, M. E. Di Pietro, M. Ferro, F. Castiglione, S. Ruellan, T. Moufawad, L. Moura, M. Costa Gomes, S. Fourmentin and A. Mele, *ACS Sustain. Chem. Eng.*, **7**, 7277–7285.
- 7 J. A. McCune, S. Kunz, M. Olesińska and O. A. Scherman, *Chem. - A Eur. J.*, 2017, **23**, 8601–8604.
- 8 T. El Achkar, L. Moura, T. Moufawad, S. Ruellan, S. Panda, S. Longuemart, F. X. Legrand, M. Costa Gomes, D. Landy, H. Greige-Gerges and S. Fourmentin, *Int. J. Pharm.*, 2020, **584**, 119443.
- 9 T. El Achkar, T. Moufawad, S. Ruellan, D. Landy, H. Greige-Gerges and S. Fourmentin, *Chem. Commun.*, 2020, **56**, 3385–3388.