Cost-effective and eco-friendly polyols-DESs for supercapacitors

Daniele Motta[1*], Giuseppe Antonio Elia[2,3], Alessandro Damin[1], Stefano Nejrotti[1], Simone Galliano[1], Claudio Gerbaldi[2,3], Claudia Barolo[1,2], Matteo Bonomo[1,2]

[1] *Department of Chemistry and NIS Interdepartmental Centre, University of Turin, Via Pietro Giuria 7, Torino, 10125, Italy*
[2] *National Reference Center for Electrochemical Energy Storage (GISEL) - INSTM, Firenze 50121, Italy*
[3] *GAME Lab, Department of Applied Science and Technology (DISAT), Politecnico di Torino, Torino 10129, Italy*

**daniele.motta@unito.it*

Efforts to reduce dependence on fossil fuels have resulted in notable advancements in photovoltaic and wind energy systems. To address the intermittent nature of these renewable sources, efficient electrochemical energy storage systems (EESS) like batteries and supercapacitors are essential for ensuring a consistent and reliable energy supply [1]. The exploration of alternative electrolytes from the traditional unstable ones has given rise to Ionic Liquids (ILs), which however tend to be expensive and corrosive to current collectors [2]. In contrast, Deep Eutectic Solvents (DESs) have emerged as a cost-effective and environmentally friendly solution [3], offering suitable properties such as high thermal stability, low vapor pressure, biodegradability and resistance to air and humidity [4].
Our research focuses on investigating DESs, specifically metal salt-polyol mixtures. By employing thermal analysis (DSC) and vibrational spectroscopic techniques (Raman and FIR), we have been able to categorize our mixtures as DES or "salt-in-solvent" and to establish correlations with the structural features of molecular components and intermolecular interactions [5], particularly hydrogen bonds. These factors are pivotal in determining the ionicity and electrochemical performance of the systems in fully assembled EES devices.

Figure 1. Essential measurements performed on our DESs.

Acknowledgements: this project has received support from Project CH4.0 under the MUR program "Dipartimento di Eccellenza 2023–2027" (CUP D13C22003520001). This study was carried out within the GENESIS project funded by the Ministero dell'Università e della Ricerca within the PRIN 2022 program. S.G. acknowledges the project NODES which has received fundings from the MUR-M4C2 1.5 of PNRR funded by the European Union - NextGenerationEU (Grant agreement no. ECS00000036).

References

[1] Notton, G., Nivet, M. L., Voyant, C., Paoli, C., Darras, C., Motte, F., & Fouilloy, A. *Renewable and Sustainable Energy Reviews*, 2018, **87**, 96.
[2] Ferrari, S., Falco, M., Muñoz-García, A. B., Bonomo, M., Brutti, S., Pavone, M., & Gerbaldi, C. *Advanced Energy Materials*, 2021, **11**, 2100785.
[3] Nejrotti, S., Antenucci, A., Pontremoli, C., Gontrani, L., Barbero, N., Carbone, M., & Bonomo, M. *ACS Omega*, 2022, **7**, 47449.
[4] Di Pietro, M. E., & Mele, A. *Journal of Molecular Liquids*, 2021, **338**, 116597.
[5] Cappelluti, F., Mariani, A., Bonomo, M., Damin, A., Bencivenni, L., Passerini, S., Carbone, M., & Gontrani, L. *Journal of Molecular Liquids*, 2022, **367**, 120443.