Sodium chloride and polyols based Deep Eutectic Solvents as sustainable electrolytes for electrochemical energy storage devices

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Nowadays, the integration of green energy sources (e.g. photovoltaic and wind) with efficient electrochemical energy storage systems (EESS), such as batteries and supercapacitors, is dramatically important to store the possible excess of energy produced and supply additional power in case of insufficient electricity supply [1]. Yet, EESS are usually based on not sustainable electrolytes, which should be progressively phased out. [2,3].

In this contribution, we proposed the use of Deep Eutectic Solvents (DES) as sustainable [4] and effective alternative to conventional electrolyte. Since their discovery, DES have been gaining growing attention due to their versatility coupled to their formulation based on inexpensive, abundant and renewable materials. In their more common fashion, DES are based on a halide salt (organic or inorganic), which acts as a hydrogen bond acceptor (HBA), and an alcohol, which acts as a hydrogen bond donor (HBD). Even though more than 15 years have passed since their discovery, fundamental research on these mixtures is still in its infancy. As a matter of fact, scientists mainly focused their efforts on the final application of DES.[5] Indeed, they were successfully employed in metal processing and extraction, as green solvents or gas absorbers and in industrial applications.

Aiming to reach wider and more effective exploitation of DES as sustainable electrolytes, a thoughtful design of a new combination of HBA and HBD is necessary. In this work, we formulated eutectic mixtures based on NaCl as HBA, and glycerol and its derivative as HBD and we deeply investigate them through a multi-technique approach (based on thermal analysis, Raman spectroscopy and electrochemistry). The most promising systems are evaluated with cyclic voltammetry and galvanostatic cycling as a further step toward practical application.

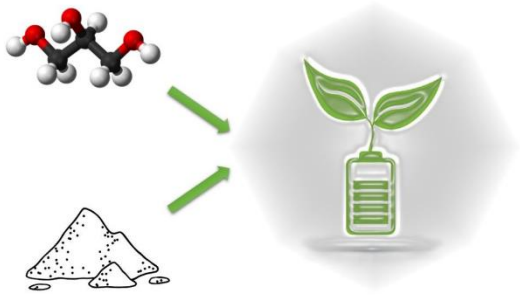

Figure 1. Glycerol and NaCl as precursor for innovative and sustainable electrolyte in EESS

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[1] Notton et al. *Renewable and Sustainable Energy Reviews*, **2018**, 87, 96
[2] Ferrari et al. *Advanced Energy Materials*, **2021**, 11, 2100785
[3] Kinnaird et al. *Routledge Handbook of the Extractive Industries and Sustainable Development*, **2022**, 13
[4] S. Nejrotti et al. ACS Omega, **2022**, 7, 47449–47461
[5] E.L. Smith et al. Chem. Rev, **2014**, 114, 11060–11082.