A comprehensive study of NaCl-polyol mixtures: affordable and green electrolytes for electrochemical energy storage systems

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Efforts to decrease reliance on fossil fuels have led to significant improvements in photovoltaic and wind energy systems. However, the intermittent nature of these renewable sources requires the integration of efficient electrochemical energy storage systems (EESS), such as batteries and supercapacitors, to guarantee a continuous and reliable energy supply [1]. The search for alternative electrolytes to the traditional unstable ones has led to the proposal of Liquid Ionics (ILs), which instead are expensive and generally corrosive to current collectors [2,3]. Consequently, Deep Eutectic Solvents (DESs) have emerged in recent years as a solution to these issues since they are more affordable, non-corrosive and possess favorable properties such as high thermal stability, low vapor pressure, biodegradability and inertness to air and humidity [4].

Our contribution in this field is dedicated to the investigation of sodium-based Deep Eutectic Solvents (DESs): in particular, the study has been devoted to NaCl-Glycerol and NaCl-Ethylene glycol mixtures. To deeply comprehend our mixtures, and to provide all the information necessary for the development in this area, a multilateral analysis has been conducted following the basic roadmap shown in Figure 1. Through thermal analysis (DSC) and vibrational spectroscopic techniques (Raman and FIR), we have managed to classify our mixtures as DES or "salt-in-solvent" and to find a correlation with both the structural features of the molecular components and the occurring intermolecular interactions (hydrogen bond) [5]. These latter play a pivotal role in establishing the ionicity of each system, as well as the electrochemical behavior in fully assembled devices (supercapacitor and sodium-ion battery).

Fig. 1 Essential measurements to have a thorough overview of DESs.

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