ISGC 2022

N°351 / OC
TOPIC(s) : Alternative solvents / Waste and side streams valorization

Teaching an old dog new tricks, solvent extraction in Type V DES

AUTHORS

Nicolas SCHAEFFER / UNIVERSITY OF AVEIRO, UNIVERSITY OF AVEIRO, AVEIRO
Sílvia J.R. VARGAS / PURDUE UNIVERSITY, PURDUE MALL, WEST LAFAYETTE
Germán PÉREZ-SANCHEZ / UNIVERSITY OF AVEIRO, UNIVERSITY OF AVEIRO, AVEIRO
João A.P. COUTINHO / UNIVERSITY OF AVEIRO, UNIVERSITY OF AVEIRO, AVEIRO

PURPOSE OF THE ABSTRACT

Recently, a new class of nonionic deep eutectic solvents (DESs), labelled as Type V DESs, in contrast to the ionic nature of Types I to IV, was identified [1]. Type V DESs exhibit strong negative deviations from thermodynamic ideality stemming from the stronger intermolecular hydrogen bonded network present in the DES relative to that of the pure components. These nonionic DESs, which are often hydrophobic, appear as promising media for the solvent extraction of organic and metallic compounds presenting low viscosity while incorporating bioderived constituents.

In this work, the challenging solvent extraction (SX) separation of Pt(IV) from Pd(II) from HCl media is investigated using type V DES composed of either decanoic acid of menthol as hydrogen bond donor and trioctylphosphine oxide (TOPO) as acceptor [2]. The extraction efficiency and selectivity varied non-linearly with the TOPO molar fraction and nature of the hydrogen bond donor, presenting an antagonism between the extraction mechanism and the intermolecular interactions of the DES components. Whilst Pt(IV) was efficiently extracted across a large range of conditions, Pd(II) extraction dropped sharply with decrease TOPO molar fraction thereby allowing for a ten-fold increase in selectivity compared to conventional TOPO-based solvent extraction systems. Furthermore, the higher TOPO concentration in DES enabled maximum loading concentrations significantly superior to those previously reported whilst the extensive number of hydrogen bonded configurations suppresses the formation of a third phase. Finally, the eutectic phase was easily regenerated and reused over multiple extraction/stripping cycles with no loss in efficiency. The results herein identify the criteria for rational type V DES selection and application, providing a new life to otherwise poorly selective extractants through their inclusion in these systems whilst removing the need for organic diluents.

Acknowledgments:
This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 and UIDP/50011/2020, financed by national funds through the FCT/MCTES.

FIGURES

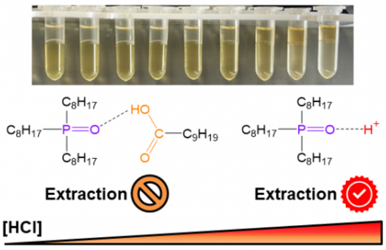

FIGURE 1

Figure 1.

Schematic of Pd(II) extraction with HCl concentration in the studied DES

FIGURE 2

KEYWORDS

Solvent extraction | deep eutectic solvent | critical metals | non-ideal systems

BIBLIOGRAPHY

[1] Abranches et al., Chem. Comm., 55 (2019) 10253 - 10256. DOI: 10.1039/C9CC04846D
[2] Vargas et al., Green Chem., 23 (2021) 4540-4550. DOI: 10.1039/D1GC00829C