Ionic Liquids in the Extraction and Recycling of Critical Metals from Urban Mines

A. P. Paiva¹ · C. A. Nogueira²

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Abstract

Ionic liquids (ILs), salts with a melting temperature below the boiling point of water, are one of the most recent fashion trends in modern chemistry. Nowadays, and taking into account the extensive research found in literature, it seems hard to imagine a sustainable world in the near future without the involvement of ILs, since they have low vapor pressure, are non-flammable, and display excellent chemical/electrochemical/thermal stabilities. Accordingly, ILs are considered to be advantageous replacers of the traditional organic solvents, therefore, much more environmentally-friendly. ILs can be easily produced to tune their physicochemical properties to specific applications, and that is the case currently occurring for several separation processes. This review aims to highlight and discuss some of the most relevant key-achievements, developed at laboratory scale, focusing on the use of ILs for the hydrometallurgical extraction of critical metals from urban mines, particularly the platinum-group metals (PGMs): ruthenium, rhodium, palladium, osmium, iridium, and platinum. A few decades of investigation brought a well-recognized scientific knowledge, still with a wide space to go, but work has yet to be conducted on testing the most promising ILs for the recycling of metals from real urban mines, and at a scaled-up level. Nevertheless, based on the most significant case-studies, the upcoming of ILs to recover critical metals from end-of-life devices for further valorization is assessed.

Graphic Abstract

Keywords Ionic liquids · Liquid–liquid extraction · Hydrometallurgical valorization · Recycling of platinum-group metals · Urban mines