Supporting information

Figure 1  The photo of the solid in the IL phase after extraction.
Figure 2 The ESI spectrum of the solid isolated from the [C₄mim][NTf₂] after extraction Lu³⁺ by washing the IL with ethyl acetate.

The peak at m/z 689.3253 can be found and it corresponds to the Lu(C₄H₈N₂)₄(NO₃)₃ (calcd. 689.3533).
Figure 3 The ESI spectrum of the solid isolated from the [C₄mim][NTf₂] after extraction La³⁺ by washing the IL with ethyl acetate.

The peak at m/z 408.3094 can be found and it corresponds to the La(C₄H₆N₂)(NO₃)₃⁻ (calcd. 407.0054).
The peaks at m/z 82.8659, 139.7869 can be found and they correspond to the 1-MIM(C₄H₆N₂, calcd. 82.0978), C₄mim⁺ (calcd. 139.2121).

The peaks at m/z 688.7801, 628.6253, 282.2807, 166.9894 can be found and they correspond to the complex of Lu(C₄H₆N₂)₄(NO₃)₃, Lu(C₄H₆N₂)₄(NO₃)₂⁺, Lu(C₄H₆N₂)₄(NO₃)³⁺ and Lu(C₄H₆N₂)₄³⁺.
The peak at m/z 139.2538 can be found and it corresponds to the \( [\text{C}_4\text{mim}]^+ \) (calcd. 139.2121).

The peaks at m/z 408.3125, 346.3347, 140.1227 can be found and they correspond to the complex of \( \text{La} (\text{C}_4\text{H}_6\text{N}_2)(\text{NO}_3)_3 \), \( \text{La} (\text{C}_4\text{H}_6\text{N}_2)(\text{NO}_3)_2^+ \) and \( \text{La} (\text{C}_4\text{H}_6\text{N}_2)(\text{NO}_3)_2^{2+} \).
The peak at m/z 689.0136 can be found and it corresponds to the Lu(C₄H₆N₂)₄(NO₃)₃ (calcd. 689.3533).
The peak at m/z 408.1126 can be found and it corresponds to the La(C₄H₆N₂)₃(NO₃)₃ (calcd. 407.0054).