Deuteration of organic phosphonic acid extractant for neutron applications

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Rare earth elements (REEs) are of increasing importance for clean technologies, e.g., wind turbines, electric vehicles, etc. To ensure a stable supply of REEs, their separation technology needs to be significantly improved, and elucidating their separation mechanisms will also help improve the efficiency of extraction systems. Recently, neutron reflectometry (NR) methods have been proven to be useful in extraction mechanism analyses for liquid-liquid extraction [C. Micheau *et al*., J. Mol. Liq. **401**, 124372 (2024)]. Hence, we have focused on the NR method to clarify the mutual separation mechanism for REEs. An organic phosphonic acid, 2-ethylhexylphosphonic acid mono-2-ethyl ester (EHEHPA) is one of the most well-known extractants for practical liquid-liquid extractions of REEs, where EHEHPA is diluted in a hydrophobic organic solvent [M. Tanaka, H. Narita, Hydrometallurgy **201**, 105588 (2021)]. To apply the NR method to this system, EHEHPA needs to be deuterated since it is very difficult to distinguish between EHEHPA and its diluent.

In this study, we have investigated a new deuteration method for EHEHPA on a gram scale. Deuteration and hydrolysis reactions of EHEHPA simultaneously occurred at >100 °C, resulting in that the deuteration ratio of EHEHPA under non-hydrolysis conditions was about 40%. The obtained deuterated (40%) EHEHPA is available for neutron experiments to control the neutron scattering contrast of EHEHPA samples.

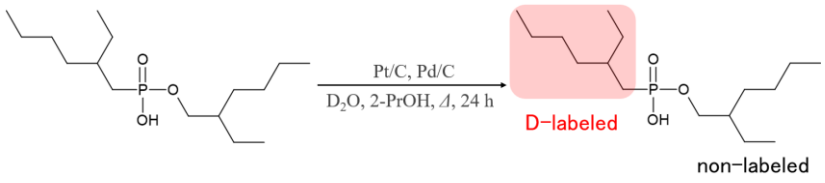

Fig. 1 Deuteration of EHEHPA.

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