

Enrichment of Rare Earth and Alkaline Earth Elements Using Consecutive Countercurrent Electromigration in Room Temperature Molten Salts

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Thermal resistant automotive three way catalysts were developed with particular attention to oxide materials including rare earths (RE) and alkaline earth metals(AE) such as supports and promoters. However, one should aware of the importance of the recycle process for the spent catalysts. For this purpose, we have applied the countercurrent electromigration using the high-temperature molten salts [1,2] for the development of the environmental friendly process depicted in Fig. 1. Since the conventional molten salts have potential hazards, e.g. high vaporization and corrosiveness to compatible materials etc, the quaternary ammonium imide type room temperature molten salts (RTMS), which is recently focused on the hydrophobic, involatile and inflammable electrolytes, were utilized in this process. As the enrichment of the RE and AE was ascertained from the batch experiments in recent study, it is necessary to develop the improved electromigration cell in order to recover the enriched salts from the melts consecutively as technological application.

The TMHA-Tf₂N salt, [n-C₆H₁₃(CH₃)₃N][N(CF₃SO₂)₂] was synthesized by the reaction of [n-C₆H₁₃(CH₃)₃N]Br, with Li[N(CF₃SO₂)₂]. In order to prepare the RE and AE salts with the common anion, the RE and AE oxides were reacted with the (CF₃SO₂)₂NH. Preparation of sample solutions (e.g., La(Tf₂N)₃ in TMHA-Tf₂N salt) were carried out to use the electrolyte of the electromigration. A series of experiments was used in the improved electromigration cell to recover the consecutively enriched salts, which has similar structure referred in [2]. The carbon rod and the tungsten wire were chosen as the anode and cathode, respectively. The migration part was packed with the alumina powder with 75 μm φ. The TMHA and RE ions were analyzed by Ion Chromatography and ICP emission spectrometry, respectively. A constant DC supplier fed the electric currents less than 0.2A and the transported charge for each electromigration was more than 1000C. The consecutive electromigration process was focused on the multistage removing process for RE and AE elements. A series of results for the continuous electromigration is shown in Fig. 2. The RE and AE ratios to the total components were much higher than the initial composition. These results enabled us to demonstrate that the consecutive electromigration method using the RTMS was applicable to the enrichment of multivalent cations and the salt bath multistage cleaning process.

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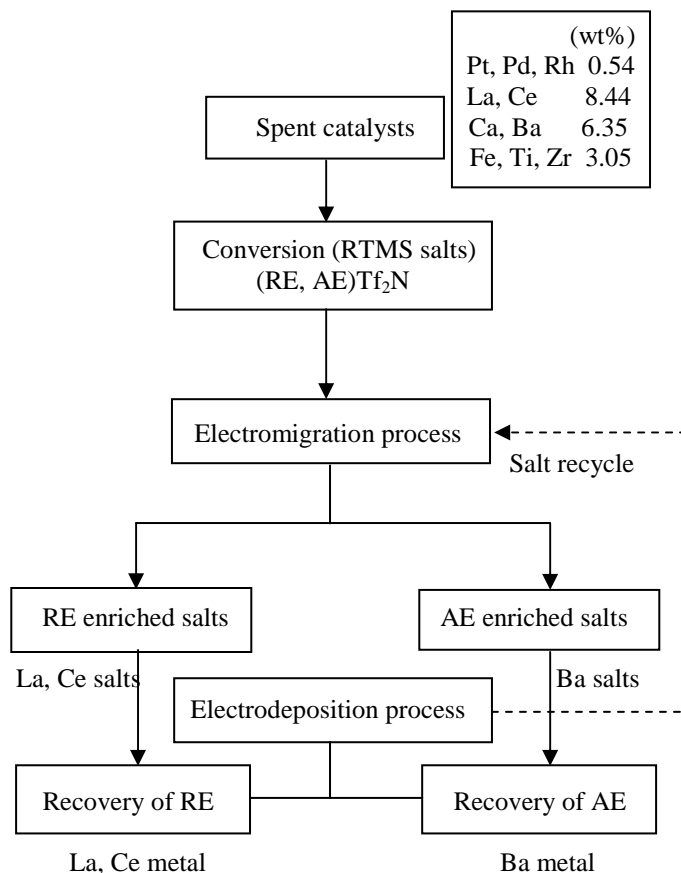


Fig. 1 The originated environmental harmonization process using RTMS to recover RE and AE separately.

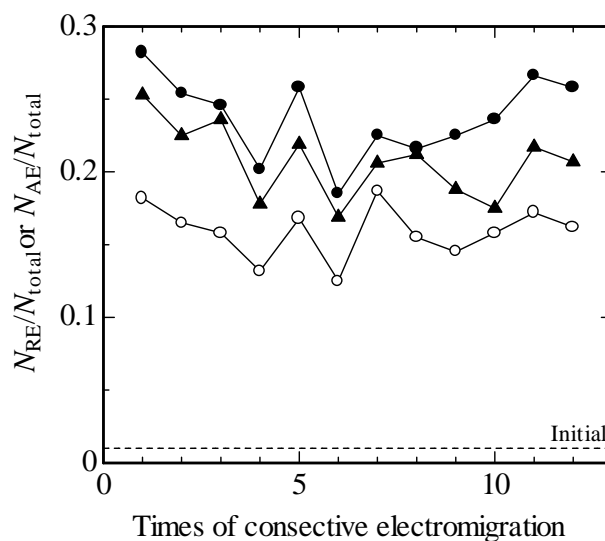


Fig. 2 The results of the consecutive electromigration using RE(Tf₂N)₃ and AE(Tf₂N)₂ in the TMHA-Tf₂N at 373K, —●— : N_{La}/N_{total}, —▲— : N_{Ce}/N_{total}, —○— : N_{Ba}/N_{total}