Metal recovery from positive electrode material of LIB by complex formation and countercurrent extraction method using supercritical carbon dioxide

Miyu Ozaki[1], Wahyudiono[1], Hideki Kanda[1],Motonobu Goto[1], Masaru Watanabe[2], Masato Shirakata[2],

[1] Department of Materials Process Engineering, Nagoya University/ Nagoya 464-8603, Japan
[2] New Industry Creation Hatchery Center, Tohoku University/ Sendai
ozaki.miyu@c.mbox.nagoya-u.ac.jp

Since the ternary lithium ion battery (LIB) is compact, light-weight, and high-energy capacity, its demand at wide application such as electric device and electric vehicle has been drastically increased. To overcome the demand, the consisted metals of the ternary LIB, which are mined at the limited countries, must be secured, and the waste ternary LIBs should be the secondary resources. The conventional processes for the recycle of ternary LIB require a large amount of strong acid, deleterious substance, organic solvents with several steps and suffer from low efficiency. Therefore, a high-efficiency and environmental-friendly recycle process, which contributes for sustainable development goals (SDGs), should be developed.

To recover the metals like lithium, cobalt, nickel, and manganese from positive electrode of waste ternary LIBs, we proposed a complete recycle system of the waste LIBs with a green solvent and biomass-derived molecules process which consists of high-efficient leaching and metal separation steps using supercritical carbon dioxide

We used the solution that positive electrode materials are dissolved in subcritical water with citric acid. Lithium, cobalt, and nickel are dissolved by forming complex with citric acid whereas manganese is obtained as solid sediment. Citric solution of metals is contacted with supercritical carbon dioxide with chelating agent such as 2,2,6,6-tetramethyl-3,5-heptanedione (THD) or acetylacetone (ACAC). Cobalt is selectively extracted and nicked is recovered as in the solution where lithium is recovered as lithium carbonate. Fig. 1 shows the schematic diagram of the extraction equipment.

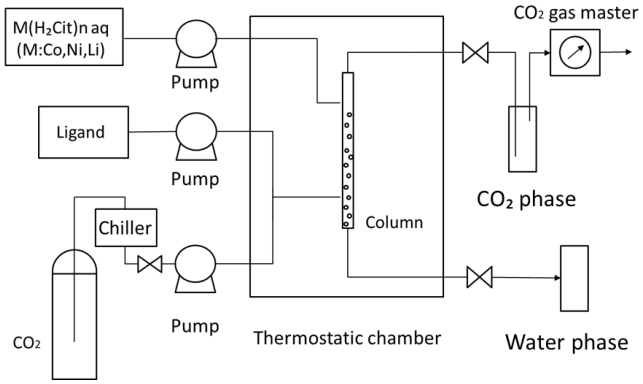

Fig.1 schematic diagram of the extraction equipment

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