HIGH-EFFICIENCY TECHNOLOGY FOR LITHIUM ISOTOPE SEPARATION USING AN IONIC-LIQUID IMPREGNATED ORGANIC MEMBRANE

T. Hoshino[1], T. Terai[2]

[1] *Blanket Irradiation and Analysis Group, Fusion Research and Development Directorate, Japan Atomic Energy Agency, 4002, Narita-cho, Oarai-machi, Higashi Ibaraki-gun, Ibaraki, 311-1393, Japan*
[2] *The Institute of Engineering Innovation and Department of Nuclear Engineering & Management School of Engineering, The University of Tokyo, 2-11-16 Yayoi, Bunkyo-ku, Tokyo, 113-8656, Japan*

Corresponding author: hoshino.tsuyoshi@jaea.go.jp

The tritium needed as a fuel for fusion reactors is produced by the neutron capture reaction of lithium-6 (^{6}Li) in tritium breeding materials. However, natural Li contains only about 7.6 at.% ^{6}Li, and enrichment of ^{6}Li up to 30 to 90% is required for adequate tritium breeding in many fusion reactor concepts.

In Japan, new lithium isotope separation technique using ionic-liquid impregnated organic membranes have been developed. Lithium ions are able to move by electrodialysis through certain ionic-liquid impregnated organic membranes between the cathode and the anode in lithium solutions. The principle is that since the mobility of ^{6}Li ions is greater than that of ^{7}Li ions, ^{6}Li can be enriched on the cathode side of a cell. The technology of ^{6}Li enrichment using ionic-liquid impregnated organic membrane was recognized as a possible method of ^{6}Li isotope separation because of its good ^{6}Li isotope separation coefficient (1.05 – 1.40), its low electricity costs and its easy scale-up, comparable to a seawater desalination plant. However, the improvement in the durability of the ionic-liquid impregnated organic membrane is one of the main issues for stable, long-term operation of electrodialysis cells while maintaining good performance.

Therefore, we developed highly-durable ionic-liquid impregnated organic membrane. Both ends of the ionic-liquid impregnated organic membrane were covered by a nafion 324 overcoat or cation exchange membrane (SELEMION^{TM} CMD) to prevent the outflow of the ionic liquid. The transmission of Lithium aqueous solution after 10 hours under the highly-durable ionic-liquid impregnated organic membrane is almost 0%. So this highly-durable ionic-liquid impregnated organic membrane for long operating of electrodialysis cells has been developed through successful prevention of ion liquid dissolution.

Furthermore, the organic membrane selected was 1, 2 or 3mm highly-porous Teflon film, in order to efficiently impregnate the ionic liquid. The ^{6}Li isotope separation coefficient by electrodialysis using 1 or 2mm highly-porous Teflon film was larger than using 3mm highly-porous Teflon film.

These results indicated that it is necessary to use highly-durable ionic-liquid impregnated organic membrane and conduct 3mm highly-porous Teflon film for high-efficiency of lithium isotope separation.

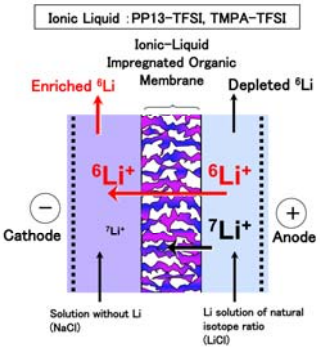

Figure 1: Basic principle of lithium isotope separation using electrodialysis.