# 4-10 Lithium Isotope Separation for Fusion Reactor Fuel

## — Development of Innovative Technology for Lithium-6 Enrichment Using an Ionic Liquid —

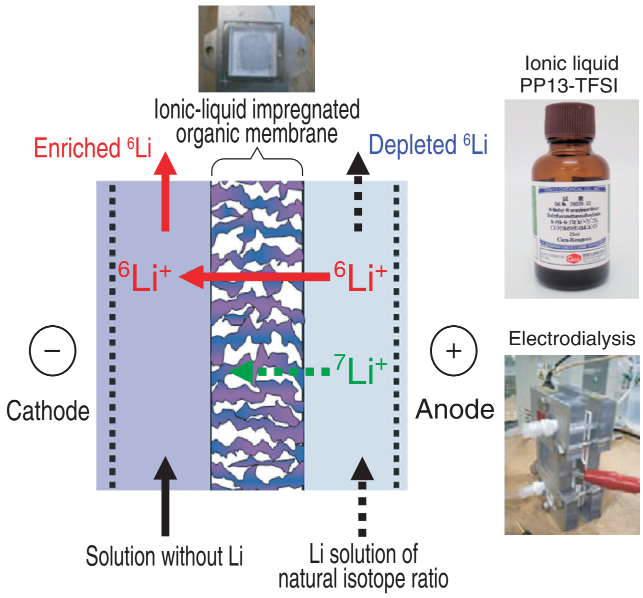


**Fig.4-24 New lithium isotope separation technique using an ionic liquid**
An ionic liquid is impregnated into an organic membrane that repels water and is used in sportswear. $^{6}$Li has a higher mobility than $^{7}$Li and will be enriched on the cathode side.

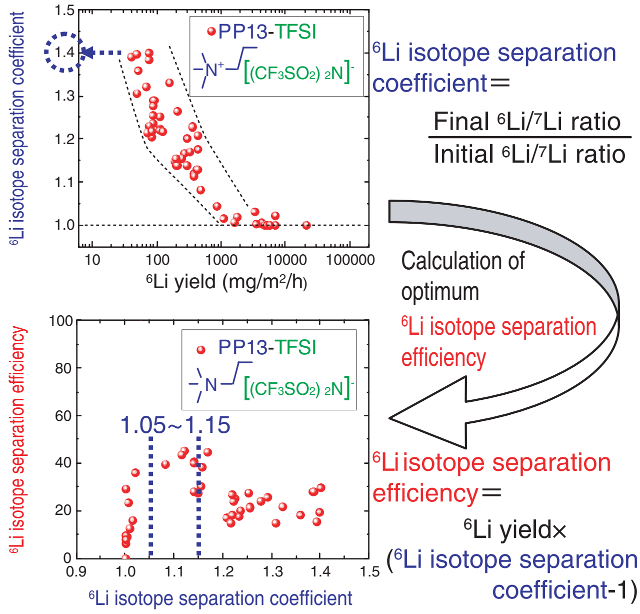


**Fig.4-25 $^{6}$Li isotope separation coefficient and efficiency**
The $^{6}$Li isotope separation coefficient of this method (1.05～1.15) is the same as or better than that of the amalgamation process using mercury (1.06).

Tritium needed as a fuel for fusion reactors is produced via neutron capture by lithium-6 ($^{6}$Li). However, natural Li contains only about 7.6% $^{6}$Li, and enrichment of $^{6}$Li up to 40～90% is required for adequate tritium breeding in fusion reactors.

The amalgamation process using mercury is the only $^{6}$Li enrichment technology in practical use overseas; however, because mercury is toxic, this method cannot be industrialized in Japan. Other methods have very low separation efficiencies and are unfit for mass production. Because it is difficult to import $^{6}$Li from overseas, the establishment of a $^{6}$Li enrichment technology that is unique to Japan is an issue of top priority for the realization of fusion reactors.

Therefore, we have proposed a new and original process that uses an ionic liquid with electrodialysis, thereby establishing an innovative Li isotope separation technology. The new approach demonstrates excellent environmental resistance, is amenable to mass production, and is highly energy efficient (Fig.4-24, Fig.4-25). Lithium ions move by electrodialysis between the cathode and the anode in lithium solutions. Because the ionic mobility of $^{6}$Li ions is higher than that of $^{7}$Li ions, $^{6}$Li can be enriched on the cathode side of a cell.

Using PP13-TFSI ($C_{11}H_{20}OF_6N_2O_4S_2$) as the ionic liquid, we obtained a maximum of 1.4 for the $^{6}$Li isotope separation coefficient (Fig.4-25, top). Furthermore, we found that it is possible to obtain the separation efficiency for the $^{6}$Li isotope that ranges from 1.05 to 1.15 (Fig.4-25, bottom). These results show that the $^{6}$Li isotope separation coefficient of this method is the same as or better than that of the amalgamation process using mercury (1.06).

Currently, Li recovery technology from seawater and used batteries is developing this technology, which is sponsored by the Funding Program for Next Generation World-Leading Researchers (NEXT Program) in the Cabinet Office, Government of Japan. In addition, this technology has become a focus of great attention by the electric vehicle industry, which depends on Li ion batteries.

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**Reference**

Hoshino, T. et al., Basic Technology for $^{6}$Li Enrichment using an Ionic-Liquid Impregnated Organic Membrane, Journal of Nuclear Materials, vol.417, issues 1-3, 2011, p.696-699.