## §13. Extraction of Negative Lithium Ions from a Lithium Added Hydrogen Plasma

Wada, M. (Doshisha Univ.)
Sasao, M.

Researches and developments to realize the injection of negative lithium ions ($Li^-$) into a fusion plasma from a negative ion source for neutral beam heating is being continued. The condition suitable for extracting $Li^-$ without decreasing the negative hydrogen ion ($H^-$) current has been investigated. The most important potential problem for this diagnostic system is the drain of metallic Li out of the ion source, which causes the break down of the electrostatic accelerator.

The temporal Li vapor pressure near the extraction electrode have to be higher than 0.1 Pa to produce enough $Li^-$. Below this vapor pressure, the diatomic fraction in the Li vapor is small, and the production of $Li^-$ is inefficient as the electron attachment process leading to the dissociation into $Li^-$ dose not take place with enough rate coefficient.[1] In Fig. 1, the $Li_2$ density in the ion source, calculated with a point model is shown. As shown in the figure, higher Li vapor pressure is favorable for the production of $Li_2$.

As higher Li vapor pressure is required for the efficient production of $Li^-$, the minimization of the Li drain out of the ion source is only possible through the decrease of the time to feed Li vapor near the extraction electrode. We have tested several types of Li ovens, and found the heater-wire-wound-type tubular oven worked most stably. Typical time history of $Li^-$ current extracted from a 6 cm diameter, 6 cm long ion source operated with hydrogen discharge is shown in Fig. 2. As shown in the figure, the time constant of the present oven is more than 1 minute and seems too large to produce a steady state beam only during the discharge period of the fusion plasma. The main reason for a large time constant of the oven is the heat capacity, and an oven heated with a thin wall tantalum tube has been designed. The time constant of the oven is as small as several seconds, but the amount of the vapor supplied is not enough with the designs so far tested.

As the oven heat capacity can not be made much smaller than the present design, a high speed valve to regulate the Li flow is the next candidate to realize the rapid control of the Li flow into the ion source. The present study of the Li injection near the extraction region includes the usage of pulse laser at a high repetition rate to create enough Li vapor pressure by laser ablation.

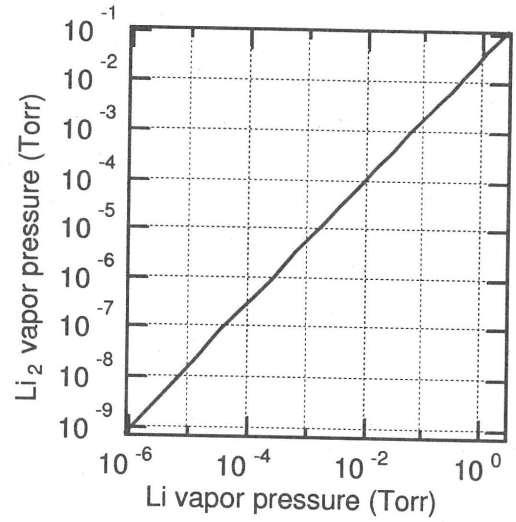


Fig. 1 Calculated $Li_2$ partial pressure plotted as a function of Li vapor pressure.

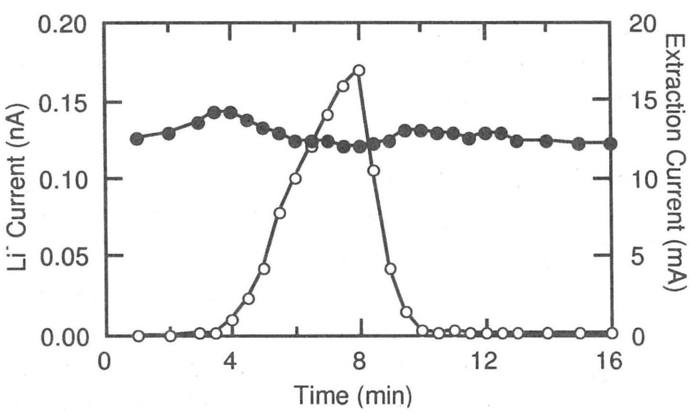


Fig. 2 Extracted $Li^-$ current plotted as function of time after turning on the tubular oven.

Reference
1)M.W.McGeoch & R.E.Schlier, J. Appl. Phys.61, 4955(1987)