§4. Control of Nonmetallic Impurities in Liquid Lithium

Tanaka, S., Yoneoka, T., Sakurai, T. (University of Tokyo), Muroga, T., Suzuki, A.

Nitrogen is a key nonmetallic impurity in liquid lithium, because it influences compatibility of structural and coating materials with lithium and tritium trapping behavior in gettering. In the present work, nitrogen control by gettering method was studied. From the viewpoints of thermodynamic stability, titanium is a good candidate (Fig. 1). However nitrogen diffusivity in titanium is small and titanium nitride is formed when the nitrogen concentration in liquid lithium is not so low. Vanadium is also a candidate for getter. Nitrogen diffusivity in lithium is relatively large although vanadium nitride is less stable than titanium nitride. One objective of the present work is to study the gettering effect of vanadium-titanium alloy. Another gettering material interested is Cr. This is reported to form Li_9CrN_5 and considered to be effective to getter nitrogen at relatively high concentration.

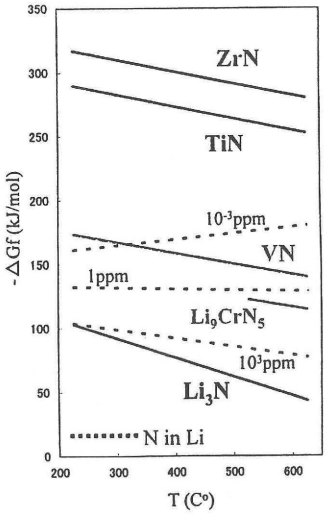

Fig. 1 Stability of metal nitrides expressed by $-\triangle G_f$

Experiments were conducted using a pot made of stainless steel. 10 to 30 grams of lithium were charged in Mo crucible with a getter. Gettering experiments were conducted using V, Ti, V-5%Ti and V-10% Ti at 673, 773 and 823K for 2.8Ms (about one month). Initial nitrogen concentration in liquid lithium was about 100ppm. From the increase in nitrogen concentration and the weight increase of gettering materials, it was concluded that Ti, V-5%Ti and V-10%Ti getter nitrogen at 823K and that V-10%Ti was most effective among tested (Fig 2). Gettering rate experiments were also conducted for V-10%Ti and Cr at 823K. In order to increase the nitrogen concentration, Sieverts' method was applied. In this method, nitrogen gas was absorbed and the amount absorbed was evaluated from the pressure drop and the volume. Nitrogen concentration was measured by an ammonium method. In this method small amount of lithium was sampled and then dissolved with water. Ammonium gas produced by the reaction of active hydrogen and nitrogen during dissolution of lithium was collected by a water bubbler and then an ammonium sensor measured the concentration of ammonium. Experimental results are shown in Figure 3. In the case of V-10%Ti, nitrogen-absorbing rate was small, because nitrogen migration through the nitride at the surface is considered to be the rate-determining step. In the case of Cr, trapping rate was found larger than by V-10%Ti. This result suggests that Cr is an effective gettering material to getter nitrogen at higher concentration.

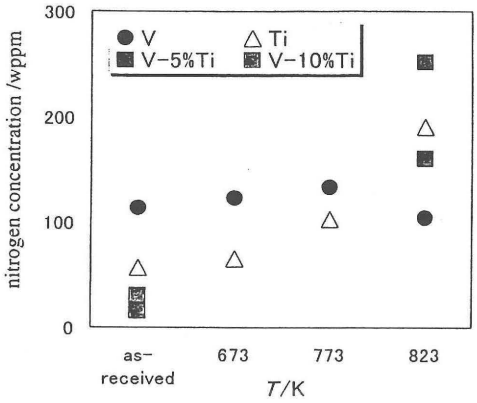

Fig. 2 Nitrogen concentration change by gettering

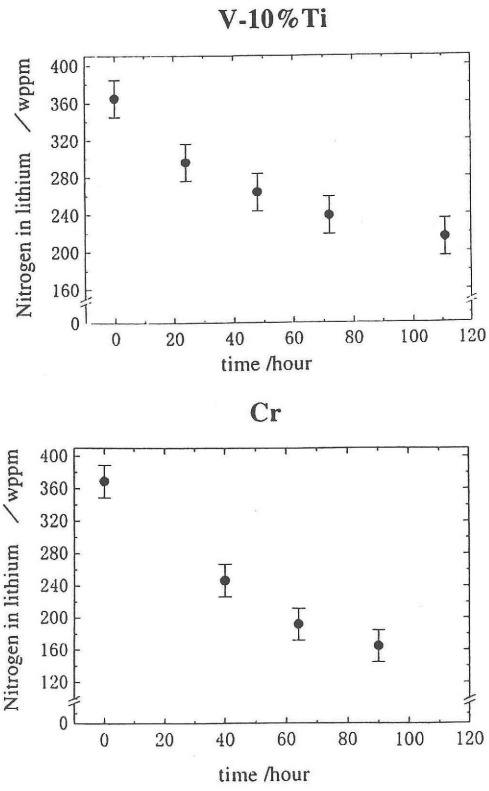

Fig. 3 Nitrogen concentration decrease in liquid lithium during gettering by V-10%Ti and Cr at 823K.