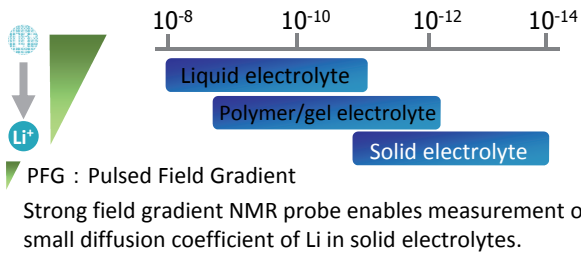


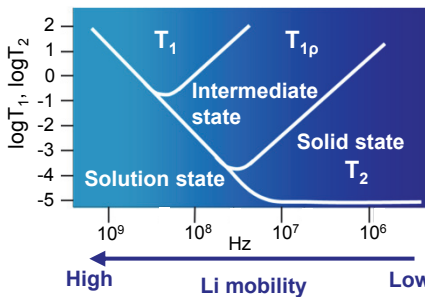
# Li ion dynamics measurement and in situ Li depth profiling of solid state electrolyte

Our services of diffusion coefficient and relaxation time analysis by NMR is useful for Li mobility evaluation. Also we provide in situ NRA analysis for depth profiling of Li around electrode/solid electrolyte interface at controlled voltages along with electrochemical data.

## Diffusion coefficient and Relaxation time measured by NMR



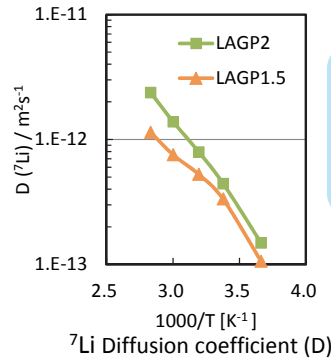
Diffusion coefficient  $D \rightarrow$  Translational Li diffusion  
Relaxation times  $T_1, T_{1\rho}, T_2 \rightarrow$  Local Li mobility



Correlation between relaxation times and Li mobility

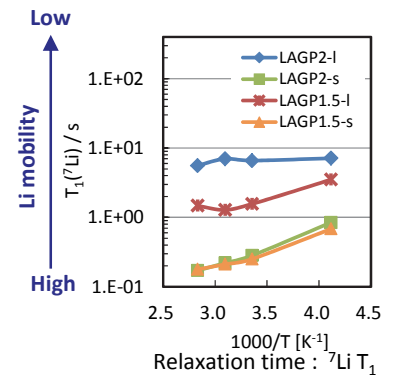
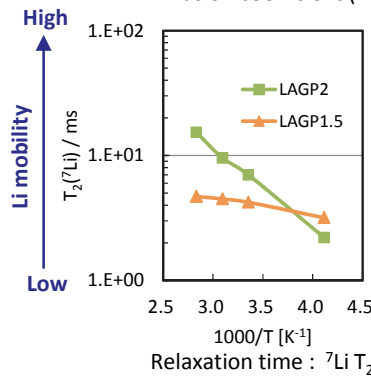
## ● Samples : LAGP Solid electrolytes

LAGP 1.5 :  $\text{Li}_{1.5}\text{Al}_{0.5}\text{Ge}_{1.5}\text{P}_3\text{O}_{12}$   
LAGP 2 :  $\text{Li}_{2.0}\text{Al}_{0.5}\text{Ge}_{1.5}\text{P}_3\text{O}_{12}$



- Temperature dependence of diffusion coefficient  $D$  and relaxation time  $T_2$  of  $^7\text{Li}$   
 $\rightarrow$  Li in LAGP 2 showed higher mobility  
- Relaxation time  $T_1$   
 $\rightarrow$  Possible existence of low mobility Li

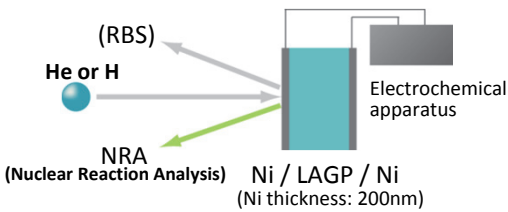
## Valuable for wide range Li mobility evaluation



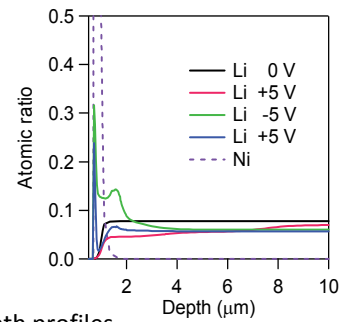
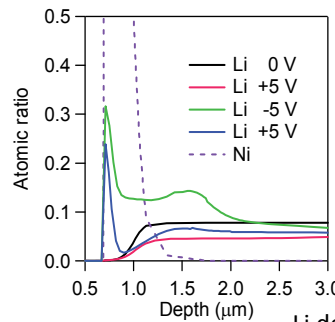
## Li distribution under applied voltage measured by *in situ* NRA

### ● Sample: Ni / LAGP 1.5 / Ni

(Ni was chosen as electrodes for its low absorbance of Li.)

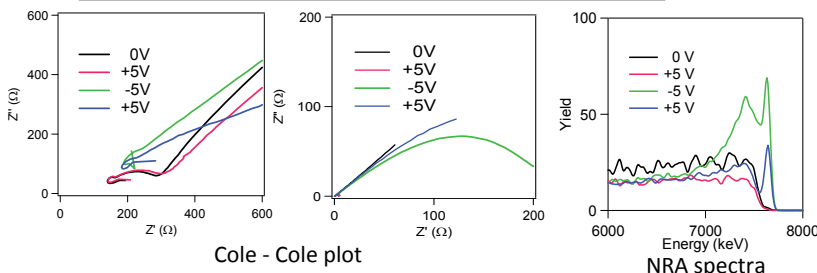


Sample is introduced into analysis chamber under inert atmosphere. After electrochemical measurements, Li depth distribution is measured at controlled voltage.



Li depth profiles

- 0V  $\rightarrow$  +5V : Increase in bulk resistivity  
 $\Leftrightarrow$  Li depletion under Ni/LAGP interface  
- +5V  $\rightarrow$  -5V : large arc in Cole-Cole plot  
 $\Leftrightarrow$  Segregation of Li to Ni surface, Li rich layer formation under Ni/ LAGP interface  
- -5V  $\rightarrow$  +5V : large arc in Cole-Cole plot  
 $\Leftrightarrow$  Remain of segregated Ni at surface



Li depth profiling at controlled voltages is beneficial for appropriate interpretation of electrochemical behavior.