New generation diffusion probe

Product used : Nuclear Magnetic Resonance (NMR)

The new generation diffusion probe is a probe specialized for diffusion applications which requires a large magnetic field gradient. By improving the design around the coil, the recovery time after the field gradient pulse has been significantly shortened compared to the conventional model. This probe is best for analyses of dynamics of high molecular weight polymer solutions with a small diffusion coefficient, nuclei with a small gyromagnetic ratio, and ions in solid electrolytes, which have been actively developed in recent years.

	Specification
Maximum magnetic field gradient	1200G/cm @ 30A 2000G/cm @ 50A
Sample tube diameter	5 mm
Available Nuclei	^{1}H, ^{19}F, (^{31}P), ^{7}Li, ^{11}B to ^{17}O,^{15}N
NMR lock	^{2}H
FG polarization	Bipolar
VT range	-70 to 120 °C
Auto Tune	Available

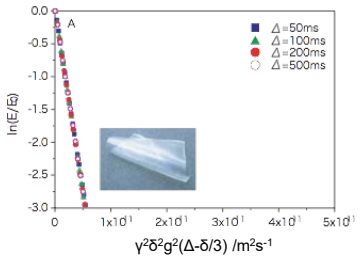
* Some of observable nuclei are subject to change

Analytical example 1
Li ion dynamics in polymer solid electrolytes.

The diffusion behavior of Li ions changes significantly depending on the difference in the higher-order structure of the polymer electrolyte. From the diffusion time (Δ) dependence of the diffusion plot, the uniformity of the diffusion motion can be investigated.

Method: ^{7}Li Stimulated Echo
Sample: Polyketone solid electrolyte (crystalline, amorphous)

Amorphous

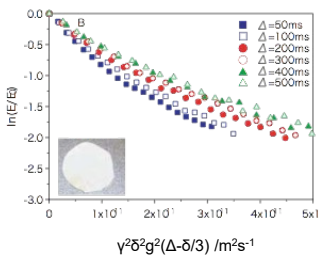


Stejskal-Tanner diffusion plot with various diffusion time

No diffusion time dependence
→ Homogeneous diffusion

Diffusion time coefficient (Δ=500ms)
$D_{Li} = 5.6 \times 10^{-11}$ [m²/s]

Crystalline



Stejskal-Tanner diffusion plot with various diffusion time

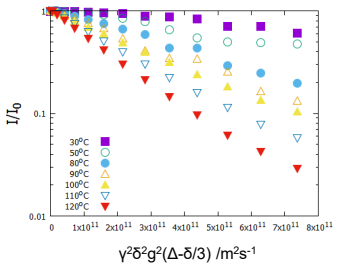
Diffusion time dependence
→ Restricted diffusion

Diffusion time coefficient (Δ=500ms)
$D_{Li} = 0.4 \times 10^{-11}$ [m²/s]

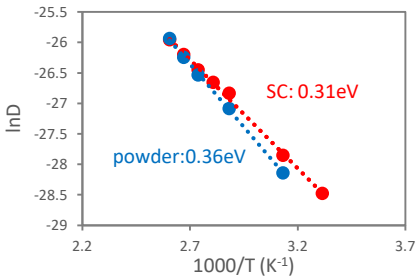
Analytical example 2
Li ion dynamics in inorganic oxide solid electrolytes.

It is also possible to analyze the diffusion behavior of Li ions in inorganic solid electrolytes with a small diffusion coefficient. The activation energy of diffusion motion can be calculated from the temperature dependence of the diffusion coefficient.

Method: ^{7}Li Stimulated Echo
Sample : LLTZO (Single Crystal, Powder)



Stejskal-Tanner diffusion plot at various temperatures.



Activation energy of diffusion motion. (An Arrhenius plot of diffusion coefficient)

Courtesy of Dr. Naoaki Kuwata (NIMS)
Dr Junji Akimoto (AIST)

Y. Hashimoto, M. Nayuki, N. Horike, and A.Yoshino, *JEOL NEWS*, vol.40

Courtesy of Asahi Kasei Corporation

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