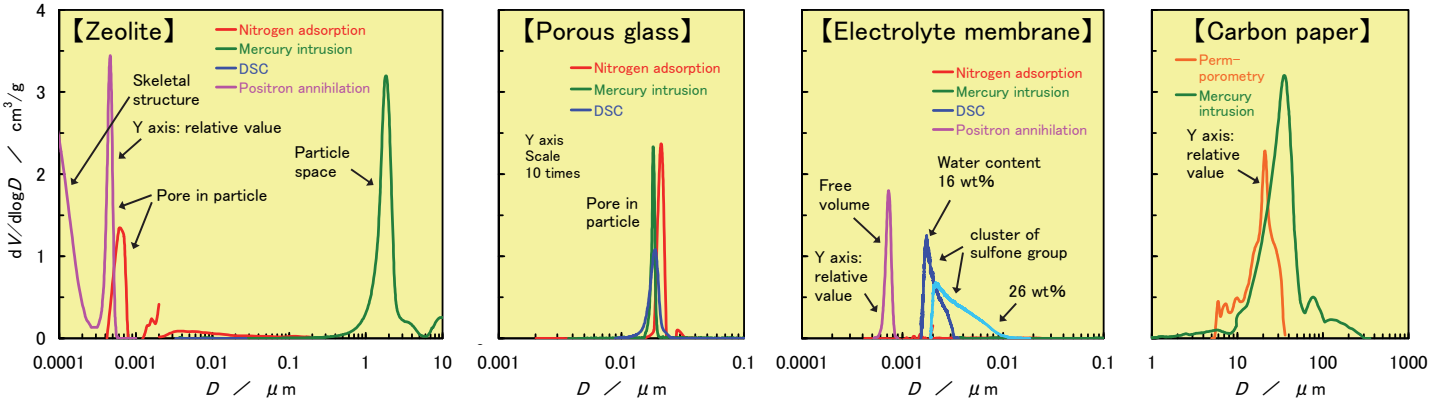
To investigate the physical properties of the surface ～Measurement techniques of surface property～

In the measurement of the pore size distribution, specific surface area and water vapor adsorption characteristics, it is important to select the appropriate measurement techniques in accordance with surface chemical state and pore size.

Pore size distribution

Comparison method: TEM, SEM, AFM, X-ray *etc.*

Method	Nitrogen adsorption	Mercury intrusion	Perm-porometry	DSC	Positron annihilation
Pore diameter	0.4 ～ 200 nm	4 nm～400 μm	0.2～200 μm	2～200 nm	0.2～5 nm
Pore shape	Open	Open	Through	Open	Closed
Limitation	Dry	Dry	Film	Wet	Dry / Film
Pore image Probe image Pore diameter	N_2 molecular Capillary condensation	Mercury Intrusion	Pressure Organic solvent	Ice Melting point depression	Positron Life time
Quantitatively	○	○	×	○	×
Main target	Activate Carbon Zeolite / Silica-gel	Electrode Separater	Carbon paper Separation film	Electrolyte Wet material	Polymer / Silica Low-k / Metal



Micro-pores in zeolite or activated carbon → Nitrogen gas adsorption
Inter-particle pore → Mercury intrusion
Skeletal structure → PALS

Pore size of the inorganic material substantially coincident with each method

Water cluster size → DSC
Free Volume → PALS

Neck diameter to dominate the fluid permeability → Perm-porometry

Surface area

Method	N_2 adsorption	Kr adsorption	CO pulse
Obtained result	BET method surface area 2～3 m^2/g <	BET method < 2～3 m^2/g 100 times sensitive	Effective surface area
Adsorption type	Physical	Physical	Chemical
Main Target	Activate carbon Zeolite Silica-gel	Graphite Small sample Thin film	Supported metal (Pt, Pd *etc.*)

Water vapor adsorption

Method	Volumetric	Gravimetric
Detector	Pressure	Mass
Condition	Water vapor only	Water vapor + Air
Temperature	5~100 °C	25～80 °C
Humidity	Relative pressure 0~1	20～80%RH (Temperature dependence)
Strong point	Rapid equilibration	Under real environment