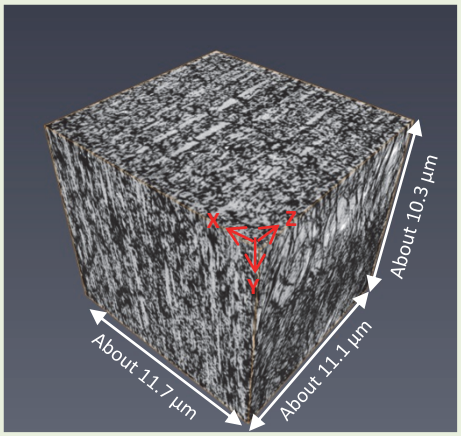
Three-dimensional network analysis of pores in lithium ion battery separator

The characteristics of the lithium ion battery are greatly influenced by the pore distribution of the separator . We introduce the case of three dimensional analysis of pore distribution for separator using FIB / SEM.

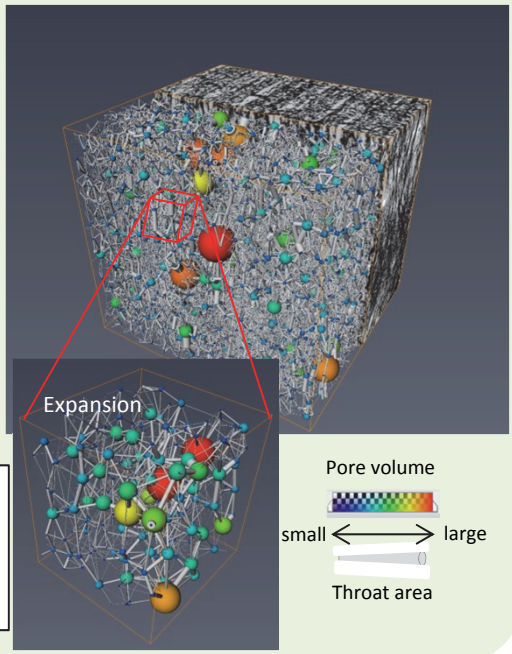
Three-dimensional observation of separator by FIB / SEM

SEM image

Three-dimensional reconstruction image



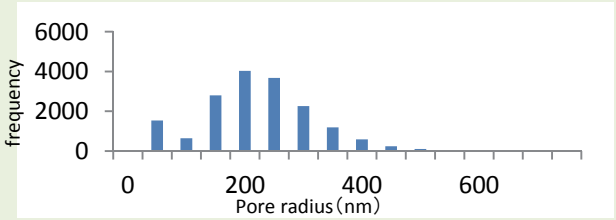
Pore network model



- It is possible to observe the three-dimensional distribution of the hole by FIB / SEM
- Holes are modeled as Pore and Throat
- Network of Pore and Throat can be visualized in three-dimensional
- Enlargement and rotation of three-dimensional reconstructed image, acquisition of slice animation are possible

Quantitative analysis using three-dimensional data

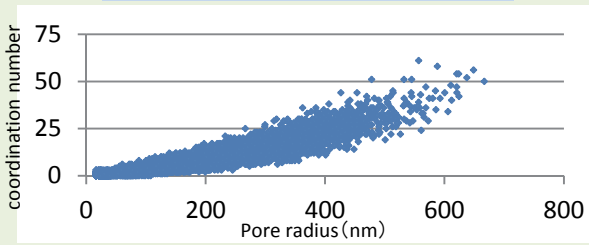
Distribution of pore radius



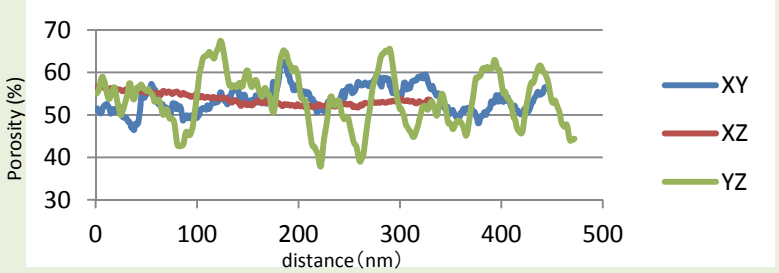
Results of Image analysis

Porosity : 47.8 (%)
Number of Pore : 17141
Number of Throat : 79100
Average volume of Pore : 55817123.6 (nm^3)
Average area of Throat : 38740.7 (nm^2)
Average radius of Pore : 197.7 (nm)
Average radius of Throat : 93.4 (mm)
Coordination number Maximum : 61 minimum : 0
Tortuosity
X-direction : 1.78 Y-direction : 1.39 Z-direction : 1.91

Distribution of coordination number



Thickness direction porosity



- Image analysis gives porosity, pore volume and radius, throat area and radius, etc.
- Calculation of each direction tortuosity is possible
- Permeability can be calculated by inputting the viscosity value of the liquid