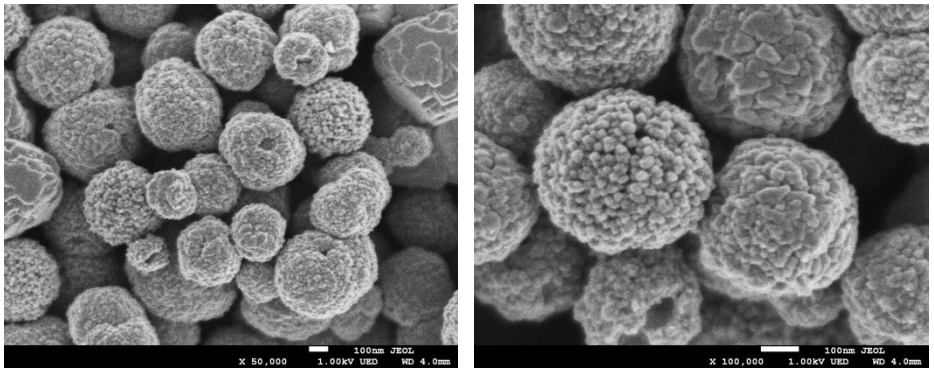
Magnetic Material Analysis Using the Super Hybrid Lens (SHL)

The SHL is a newly designed objective lens for high-resolution observation at low accelerating voltages. Unlike the semi-in lens SEM, with a large electromagnetic field below the lens, which was widely used for high-resolution, low kV observation, the SHL achieves high resolution by superimposing a magnetic field onto the electrostatic field to suppress magnetic field leakage. Therefore, the SHL is suitable for the high resolution observation of magnetic materials and electron backscattered diffraction (EBSD) even at short WD, which were difficult with the semi-in lens type SEMs. The SHL type SEM can also be configured for low vacuum operation while the semi-in lens type cannot. Examples of high resolution observation of magnetic materials and EBSD measurements are shown below.

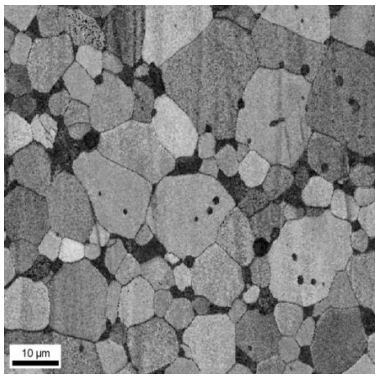


Sample: Fe_3O_4 magnetite nanoparticles

Low accelerating voltage, high resolution observation can be easily performed even with magnetic materials.

Images courtesy of Professor Tadafumi Adschiri of the Institute of Multidisciplinary Research for Advanced Materials, Tohoku University.

Figure 1: High resolution, low kV imaging of magnetic nanoparticles



Number of points: 118,585

Dimensions: X Max: 80.00 microns, Y Max: 79.89 microns

Step Size: 0.25 microns

Phase: $Nd_2Fe_{14}B$

Figure 2: EBSD of a neodymium magnet

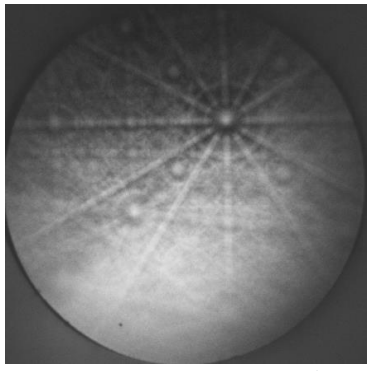


Figure 3: EBSD pattern acquired at a random point on the sample.

The SHL has no electromagnetic leakage flux below the lens making it suitable for EBSD by minimizing pattern distortion even at very short WD. As shown in the figure below, IPF mapping allows accurate confirmation of the crystal grain orientation with a very high indexing rate.

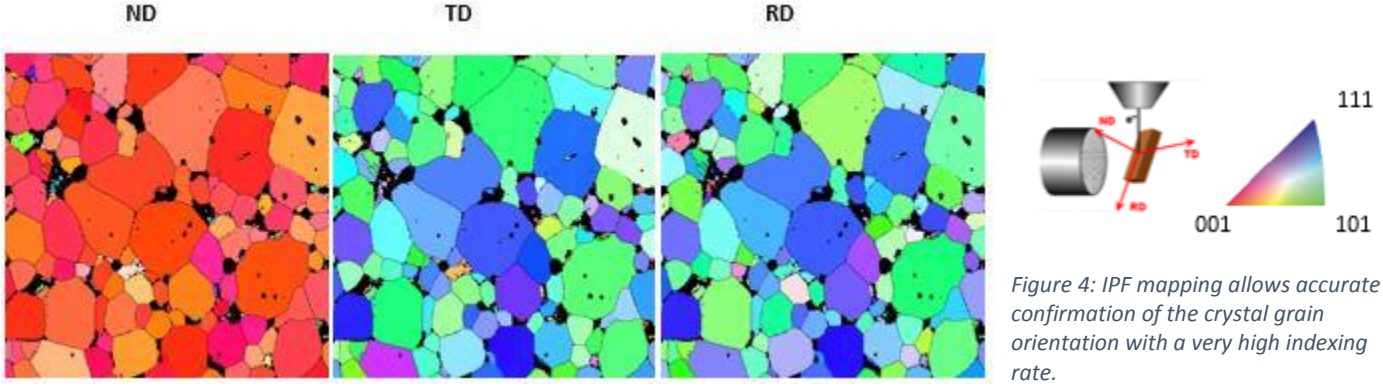


Figure 4: IPF mapping allows accurate confirmation of the crystal grain orientation with a very high indexing rate.