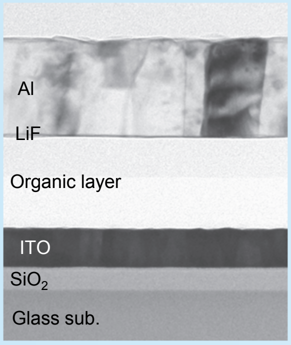
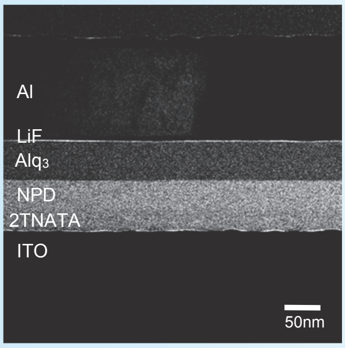
Nano-Scale Structural Analysis of Layers and Interfaces in OLED devices

Organic layers with similar composition can be distinguished by TEM with our original contrast enhancement. By TEM-EDX with large-aperture detector, we can observe the thin layers and light elements, which are undetectable by conventional TEM-EDX. GCIB-TOF-SIMS enables depth profiling of organic materials and thus is useful for operational degradation analysis of OLED devices.

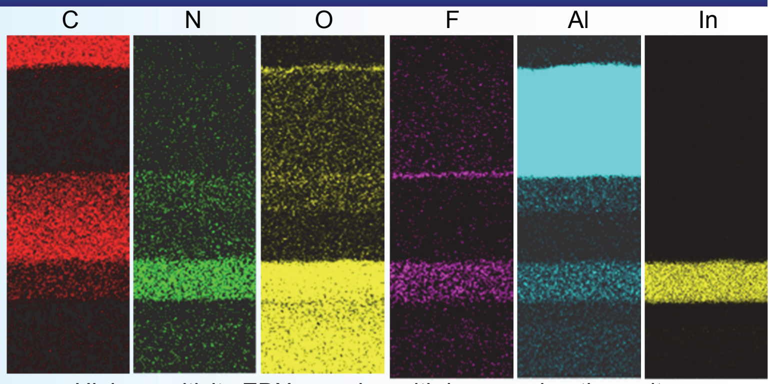
Characterization of multilayer structure of OLED by TEM-EDX



TEM image



High-contrast TEM image

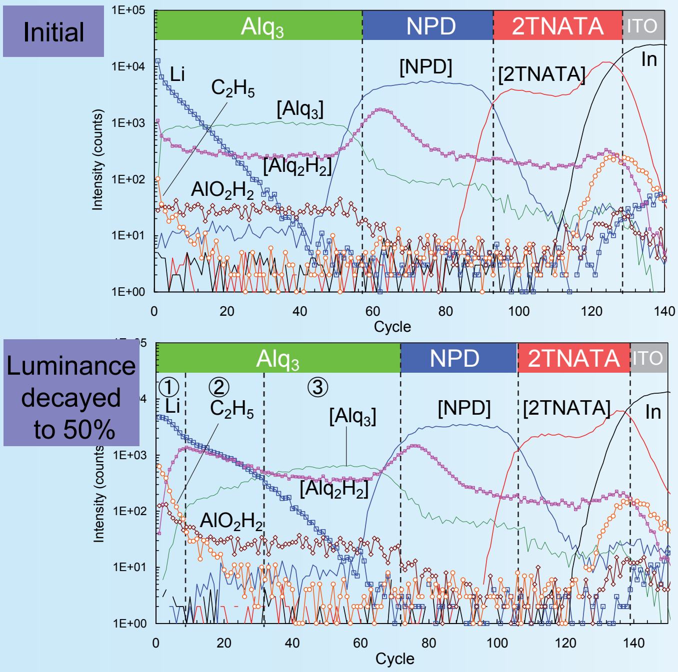


High-sensitivity EDX mapping with low acceleration voltage

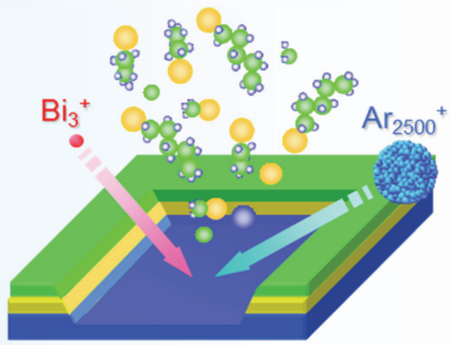
Cross section TEM observation can reveal various characteristics of multilayered films with nanometer-level resolution, such as layer thickness, interface structure and crystallinity. Even the organic layers with similar composition can be distinguished by our original contrast enhancement.

Composition analysis at nanometer resolution can be performed by TEM-EDX and TEM-EELS. We can observe the components of ultrathin layer and light elements by using large-aperture SDD-EDX detector and electron beams with low-acceleration voltage (80 kV). The layer thickness can be estimated from elemental mapping and determined more precisely by comparing with TEM image.

Operational degradation analysis of OLED by GCIB-TOF-SIMS depth profiling



GCIB-TOF-SIMS depth profiles



Schematic diagram of GCIB-TOF-SIMS

Depth distribution of main components and impurities in OLED samples (initial, 50% luminance decay) were compared by GCIB-TOF-SIMS analysis.
In the 50% luminance sample, $[Alq_2H_2]^+$ is stronger at the cathode side of the Alq_3 layer, indicating the decomposition of Alq_3 and the generation of degradation products like Alq_3H. In addition, Al oxide was detected at the interface of Al/Alq_3.

Toray Research Center, Inc.