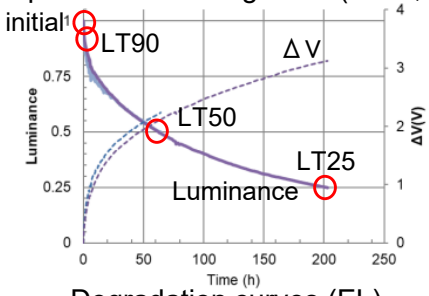
Degradation analysis of p-i-n type OLED

OLED devices mostly have positive-intrinsic-negative (p-i-n) doped layers, which drastically improve performance of OLED devices. Highly sensitive techniques are effective to analyze the small-amount components such as a degradation product or dopant.

OLED: Organic light emitting diode

1. Sample

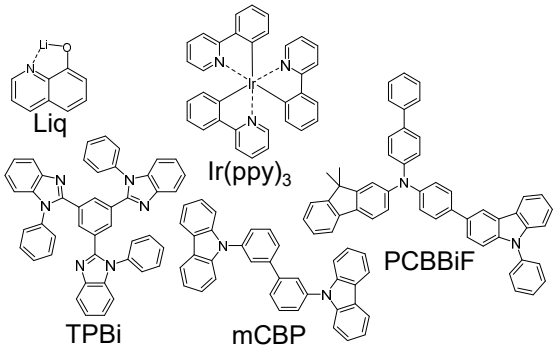
Sample: initial and degraded (LT90, 50, 25) OLED devices



Degradation curves (EL)

cathode: Al (100 nm)
EIL: Liq (2 nm)
ETL: TPBi, 50% Liq (50 nm)
EML: mCBP, 6% Ir(ppy)$_3$ (30 nm)
HTL: PCBBiF (10 nm)
HIL: PCBBiF, 3% PD (30 nm)
anode: ITO (100 nm)

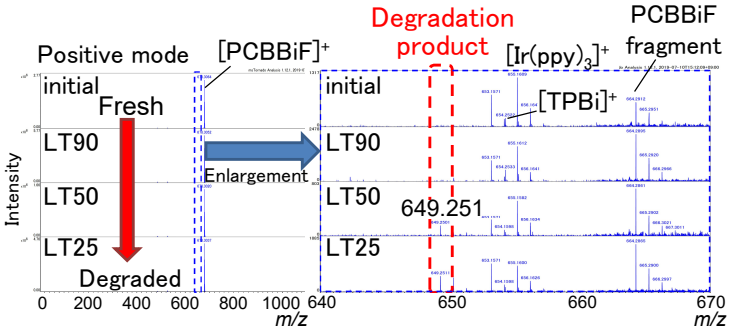
OLED stack



Chemical structures of the components

2. LDI-MS

Features;
High sensitivity, high mass resolution and accuracy



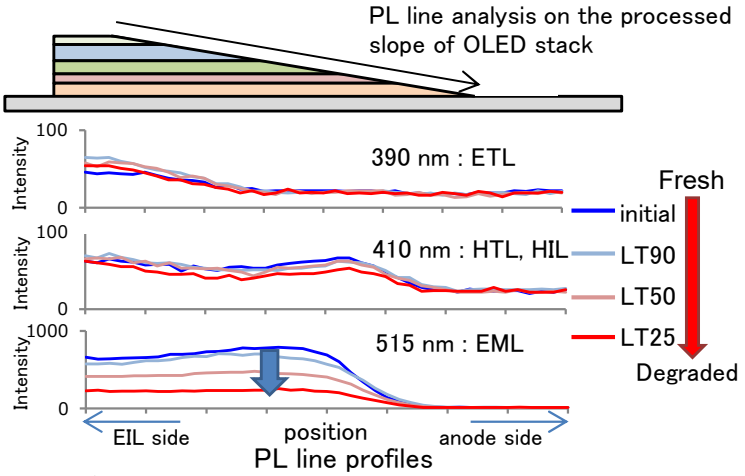
LDI-MS spectra of OLEDs

✓ Detection of a degradation product

✓ Identification of *m/z* 649.251 peak as $C_{48}H_{31}N_3^+$

3. Photoluminescence (PL)

Features;
Direct observation of luminescence property of each layer



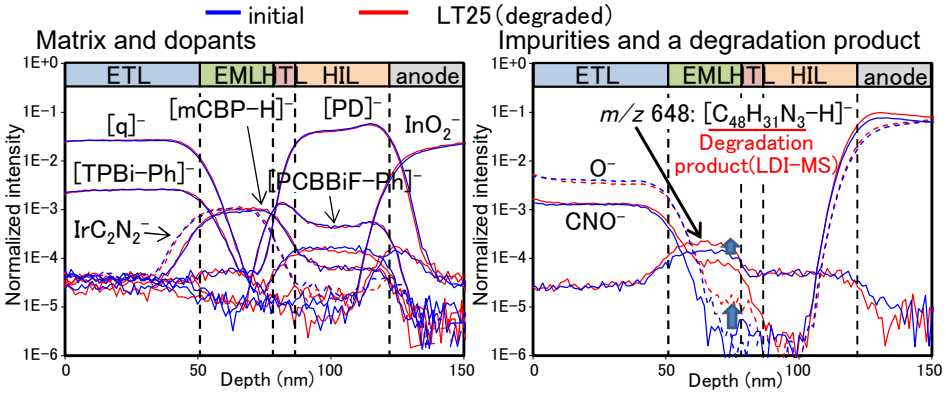
PL line profiles

✓Decrease of emission from EML

→Degradation in EML

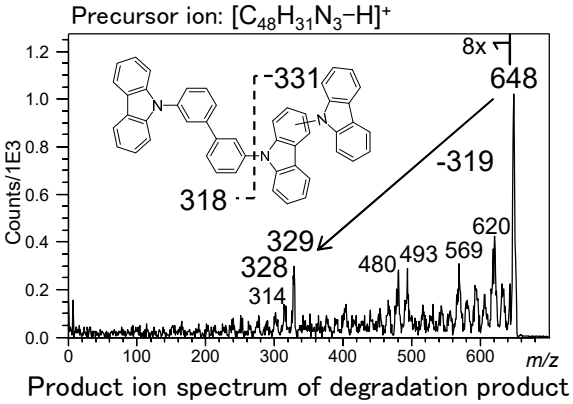
4. GCIB-TOF-SIMS and MS/MS

Features;
High sensitivity, 3D distribution analysis, structural analysis in thin layer (> several nm)



Negative depth profiles of initial and LT25 OLED devices

✓Increase of a degradation product and oxygen in EML



Product ion spectrum of degradation product

✓Structural information of the degradation product

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