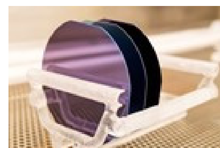
Composition and density analysis in OLED devices using micro-RBS

We have the world's first introduced a high spatial resolution RBS system.
Accurate composition and density evaluation of small area can be realized by using High energy micro-ion-beam. The composition and density analysis of the IGZO layer in the flexible OLED device and Ir quantification in the emission layer are shown.

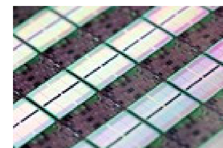
1. Introduction of New RBS

	Conventional RBS	New RBS
Available Information	Accurate composition, depth distribution / density (film thickness is required)	
Minimum spot diameter	2 mmφ	2 μmφ
new feature		Micro analysis: μRBS High mass resolution - Highly sensitive detection light elements

Conventional RBS:
Spatial resolution 2 mmϕ
Applicable only for blanket/model sample



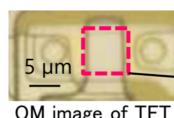
New RBS:
Spatial resolution 2 μmϕ
Applicable also for actual devices



- **It is possible to perform high-precision compositional analysis using the same method through all stages from material development to production.**

2. Elemental composition and density analysis of the small area of IGZO layer in TFT

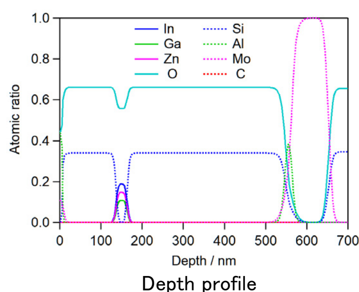
Sample : Flexible OLED device
Objective: Accurate composition and density analysis of IGZO layer in TFT
Conventional method : Composition can only be semi-quantified by Auger electron spectroscopy or TEM-EDX.
There is no method for density evaluation in micro region..



OM image of TFT

μRBS measurement & simulation analysis

Microion beam.(~2 μmϕ) irradiated to the gate area.



Depth profile

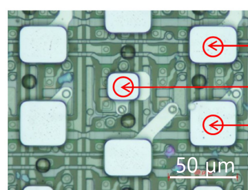
Composition and density quantification results

[atomic %] In	Ga	Zn	O	density [g/cm3]
18.8	10.8	14.8	55.6	6.6

- Advanced pretreatment + Measurement of microscopic area → Accurate compositional analysis of micro areas is possible.
- **Density evaluation of micro areas made possible for the first time.**

3. High-sensitivity quantification of dopants in OLED emitting layers

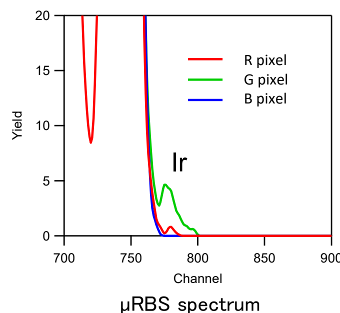
Sample : Flexible OLED device
Objective : Accurate determination of Ir complex in the luminescence layer in each RGB pixel
Conventional : SIMS is the only method sample comparison, accurate quantification difficult



G pixel
R pixel
B pixel

OM image of RGB pixel

Microion beam.(~2 μmϕ) irradiated to each RGB pixel.



μRBS spectrum

Ir quantification results for each pixel

pixel	Ir [atomic %]
R	0.01
G	0.09
B	LOD

- **Establishment of a method for accurate determination of Ir in the luminescent layer.**

Realization of high-precision composition and density analysis using the same method from raw materials to final products. ⇒ Direct comparison of OLED device characteristics and fabrication conditions is possible.
Our new RBS contributes to accelerating the research and development and clarifying the essential causes.

P02313表面科学第2研究室20210902-1

Toray Research Center, Inc.