Application Note WDXRF1063

View on rigaku.com

XRF1063 - Thickness/composition of ITO thin film by FP method

Introduction

Touchscreen panels have nowadays become common displays used for many electronic products such as ATMs, ticketing machines, home appliances, laptops, tablets, gaming consoles, music players and smart phones. Its unique function is realized by thin layers known as transparent electroconductive film built into the display which is electrically conductive and optically transparent. Indium tin oxide (ITO) is one of the most widely used transparent electroconductive materials. Its elemental composition and film thickness are important parameters determining the characteristics of touchscreen panels and therefore the quick, simple and accurate analysis of ITO film is important.

X-ray fluorescence (XRF) analysis is an established method for the analysis of thin films for both thickness and elemental composition in various fields such as the semiconductor industry. For this type of analysis, it is necessary to use fundamental parameter (FP) method in order to obtain accurate and precise analysis results since X-ray intensities are influenced by both of concentration and thickness. Rigaku is the pioneer of commercially available X-ray instruments equipped with FP method software and therefore has an advantage for this type of analysis due to extensive experience.

This application note demonstrates that Supermini200 with FP method can perform analyses with high precision and easy operation.

Instrument

The Supermini200 is a benchtop sequential WDXRF spectrometer specifically designed to deliver excellent performance while eliminating conventional installation requirements such as cooling water, special power supply and large floor space. By selecting the optional sealed proportional counter instead of the gas flow proportional counter, requirement of P10 gas can be eliminated as well, realizing a truly utility free WDXRF instrument.

Featuring a unique air-cooled 200W X-ray tube, two detectors, three analyzing crystals and with selectable vacuum or helium environment, the Supermini200 can analyze elements from oxygen to uranium.

The Windows®-based software used to operate the Supermini200 shares the same platform running Rigaku's popular high-power WDXRF ZSX family instruments. This means that it has the same advanced algorithms, multiple language support and an intuitive user-friendly interface.

Measurement

The X-ray intensities of In-Lα line and Sn-Lβ1 line from the ITO film were measured. The thickness and the concentration were calculated by the FP method. The sensitivity curves were obtained by measuring In_2O_3 reagent for In-Lα and SnO_2 reagent for Sn-Lβ1. The counting times for both lines were 120 sec. for peak and 120 sec. for background.

Rigaku's thin film software is able to handle up to 10 layers and 100 elements.

Results

Repeatability result for an ITO thin film test sample deposited on alkali-free glass is shown in Table 1. For the FP calculation, the ITO density was assumed to be 7.1 g/cm³ and the SnO_2 content was set as the balance component. The highly precise result demonstrates that Supermini200 is accurately and simultaneously able to perform thickness and content analysis.

Table 1: Analysis results of an ITO thin film test sample

	Thickness (nm)	**In_2O_3 (mass%)**	**SnO_2 (mass%)**
N=1	104.7	90.8	9.2
2	105.1	90.5	9.5
3	105.2	90.7	9.3
4	105.0	90.5	9.5
5	105.4	90.4	9.6
6	105.3	90.3	9.7
7	105.0	90.6	9.4
8	105.1	90.4	9.6
9	105.2	90.6	9.4
10	104.9	90.5	9.5
Average	105.1	90.5	9.5
Std. dev.	0.20	0.15	0.15
C.V. %	0.19	0.17	1.6

Conclusions

FP quantitative analysis for ITO thin film sample was carried out using the benchtop WDX Supermini200. Good repeatability results were quickly and easily obtained for both thickness and content.

The Supermini200 is easy to operate and has minimal installation requirements. As a pioneer of the FP method, Rigaku's accumulated experience is especially advantageous for thin film application.

Related products

Supermini200

Benchtop tube below sequential WDXRF spectrometer anal
yzes O through U in solids, liquids and powders