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Optical functional films - Scanning microscope test methods for apparent quality

光学功能薄膜 表观质量的扫描显微镜测试方法

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Table of Contents

Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part

1.Structure and Drafting Rules of Standardization Documents". Drafting. Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents. This document was proposed by the China Petroleum and Chemical Industry Federation. This document is under the jurisdiction of the National Technical Committee on Standardization of Optical Functional Thin Film Materials (SAC/TC431). This document was drafted by: China Lucky Group Co., Ltd., Hefei Lucky Science & Technology Industry Co., Ltd., and the Technical Research Institute of Physics and Chemistry, Chinese Academy of Sciences. Institute, Ningbo Jizhi Technology Co., Ltd., Jiangyin Huamei Optoelectronic Technology Co., Ltd., Anhui Provincial Institute of Product Quality Supervision and Inspection. The main drafters of this document are. Xia Jiangnan, Gao Jianhui, Zhou Di, Tian Kun, Sun Luyang, Liu Shijun, Qi Haichao, Liu Yulei, Wang Shangdan, and Sun Jingjing. Xu Qianqian, Zhou Shuyun, Yu Yang, Yao Bangben, Ding Yan. Scanning microscopy of the apparent quality of optical functional thin films Test methods Warning. This document complies with all normal and acceptable precautions regarding the use of high-voltage and laser-generating equipment.

1.Scope This document describes the imaging of optically functional thin-film products using scanning electron microscopy (SEM) and laser scanning confocal microscopy (CLSM). Methods for testing appearance quality. This document applies to optically functional thin films.

2 Normative references

This document has no normative references.

4 Testing Principle

4.1 SEM utilizes the interaction between an electron beam and a sample, employing electron optics systems and signal detection and processing systems to achieve high-resolution microscopic imaging. Observe the shape and form.

4.2 CLSM utilizes a monochromatic laser scanning beam to form a point light source through an illumination pinhole, scanning every point on the focal plane within the sample. The irradiated points on the sample are imaged at the detector's pinhole, and the images are received point by point or line by line by the photomultiplier tube behind the pinhole, and quickly processed in calculations. A fluorescent image is formed on the monitor screen, and the illumination pinhole and the detection pinhole are conjugate with respect to the focal plane of the objective lens.

4.3 Comparison of resolution and accuracy between SEM and CLSM. SEM is used to observe nanoscale defects, while CLSM is used to observe submicron-scale defects. Disease point.

4.4 This document uses SEM and CLSM to examine defects such as intrafilm spots, extrafilm spots, pits, scratches, and grooves on the surface of optical functional thin films. Conduct testing.

5.1 SEM

5.1.1 The resolution of SEM is better than 50nm.

5.1.2 The test parameters for analyzing optical functional thin film samples are as follows: accelerating voltage 0.1kV~20kV; working distance 5mm~60mm; Sample tilt angle. -15° to 60°.

5.2 CLSM

5.2.1 The semiconductor laser wavelength of CLSM is 661nm, with a resolution better than 500nm, and a 300mm wafer stage.

5.2.2 It has 3D measurement capabilities.

6 Environmental conditions and calibration

6.1 Environmental Conditions The testing equipment should be placed on a stable laboratory workbench, and the testing environment should be adjusted to the required testing temperature and relative humidity. Unless... Different end-use requirements dictate different conditions; otherwise, SEM should be performed at a temperature of (20±5)°C and a relative humidity of less than 70% (without cooling). The test should be conducted at a temperature of (20±5)°C and a relative humidity of less than 20% or greater than 80% (non-condensing).

6.2 Calibration Calibrate your instruments regularly using standard laboratory guidelines and manufacturer recommendations.

7 Experimental Procedure

7.1 SEM method The SEM experimental procedure for analyzing optical functional thin film samples is as follows:

a) Mount a sample with a minimum size of 2mm x 2mm onto the sample stage. Non-conductive samples need to be sputtered using an ion sputtering system. It was placed in the SEM sample chamber and a vacuum was drawn;

b) Activate the electron beam when the "ON" button is operable;

c) Move the sample and focus on the defective area, avoiding deformation;

d) Adjust the magnification to focus and correct astigmatism in the image, ultimately obtaining a clear image;

e) Record images;

f) Turn off the SEM electron beam and remove the sample from the sample chamber.

7.2 CLSM Method The CLSM experimental procedure for analyzing optical functional thin film samples is as follows:

a) Take a sample with a maximum size of 70mm x 70mm. The sample should be clean and intact during preparation.

b) Turn on the power to the controller, measuring head, and control computer, ensuring the instrument has been running for at least 30 minutes before operation;

c) Start the observation software and initialize (return to the initial position) the camera position;

d) Place the prepared sample on the stage and press it firmly to secure it;

e) Information Acquisition. Under the lowest magnification, coarsely adjust the sharpness of the sample, then manually adjust the stage to the defective area of the sample. By adjusting the magnification of the objective lens, the image can be focused and finally obtained in clear two-dimensional and three-dimensional images.

8 Results Analysis

8.1 SEM for two-dimensional data analysis.

8.2 Open the system analysis software CLSM and perform data analysis on two-dimensional and three-dimensional graphs, including dimensions, surface roughness, and surface morphology. Once data processing is complete, save and export it to a spreadsheet.

8.3 Defects in the image may include one of the following. intra-membrane spots, extra-membrane spots, pits, scratches, or grooves; or two of these may occur simultaneously. Any situation on the membrane, such as. intramembrane point and pit, intramembrane point, extramembrane point and pit, intramembrane point, extramembrane point, pit and scratch, intramembrane point, extramembrane point Points, dents, scratches, grooves, etc. See Appendix A.

9 Test Report

The test report should contain the following information.

a) Relevant photographs should include the sample name, test date, voltage, magnification, and scale;

b) Equipment manufacturer and model;

c) Any inconsistencies with this document should be documented and described in detail;

d) Test data and result description.