JY Division Information

Thin Film

Products and Technologies of the Thin Film Division

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The Thin Film Division of Jobin Yvon (JY), primary activity consists of the study, development and manufacturing of instruments for Thin Film Metrology and in-situ process control by utilizing techniques such as Spectroscopic Ellipsometry, Optical Emission Spectroscopy, and Imaging Interferometry. The competitive edge of our products is based on the originality of the technology, analytical methodology, and data management capabilities .In this paper, will be provided a general overview of the Thin Film Division expertise and products range.

1 Introduction

Thin film materials pervade our every day life. We are familiar with transparent conductors in LCD watches and computer displays, defrosters for automobiles, antireflection coatings, glass coatings for both colour and energy efficiency, solar cells, a whole host of electronic devices and even inside food packaging. Without thin film technology our way of life would not be the same. Only 25 years ago the variety of deposition and etching processes for preparing thin film based devices was limited. Today a certain level of sophistication and complexity has been achieved, and the industry experiences rapid technological changes, where new products and processes are continuously developed. These changes give rise to the growing need for "Thin Film Metrology and Advanced Process Control System".

With its highly skilled Jobin Yvon (JY)'s R & D team combined with a strong partnership with Ecole Polytechnique, the most prestigious research institution in France, and an intensive collaboration program with the Scientific Community and Industry through European Project, the Thin Film Division follows closely the market needs and develops innovative technologies as it will be described below.

2 Thin Film Metrology : Spectroscopic Ellipsometry

Based on the measurement of the change in light polarization upon reflection from a sample surface, Spectroscopic Ellipsometry is a highly sensitive non-destructive technique providing information related to thickness from few Å to several nm, optical properties, phase composition, surface properties and morphology of thin films and interfaces and have recently emerged as powerful tools in the thin film metrology.

Following its tradition of innovation, the JY's spectroscopic ellipsometer are based on phase modulation and an entirely numerical data acquisition and processing system. These features allow for a robust design with no mechanically moving parts, and for rapid and precise measurements. They are designed with the same high quality optics that our company has been known for since the early 1800's. The first line of ellipsometry products was introduced early 1990's and is in use at many of the world's most prestigious universities and industry sites, and led in 1992 to an award from the French Society of Physics and in 1996 to an award from the french research institution CNRS.

From Deep UV (157 nm) to NIR (2.1μm), a wide range of Ellipsometers, the UVISEL series are available for research and industry. Recently, a deep involvement in a Global Technology Alliance program with the Semiconductor Division of the HORIBA Group, led to the development of the UT-300 (Fig.1) a fully automated ellipsometer for ultra-thin film analysis dedicated to the next 300 mm generation.

Fig. 1 Fully Automatic Ultra-thin-film Measuring System, UT-300

3 Advanced Process Monitor for Process Control

Based on innovative technologies, smart sensors, and a unique software architecture including analytical methodology, and a sophisticated signal processing, a new generation of Multi Sensor Platform for Advanced Process Control of complex processes was developed. The goal of this platform is to perform data acquisition and data management and is based on a flexible and modular architecture which allows the user to tailor a solution to his needs. The system provides a common data base to store information on runs from different chambers which is very useful for Advanced Process Control modeling. A key part of the system is the availability of a variety of smart sensors each designed to monitor specific process steps and critical parameters in the same or different chambers of a cluster tool.

JY offers a comprehensive range of sensors for in-situ process control, allowing the synchronisation of complementary diagnostic tools (Fig. 2).

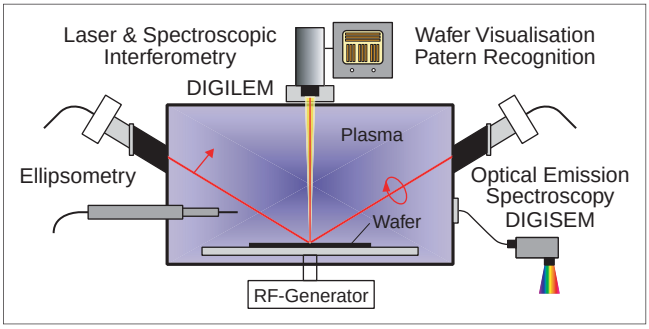

Fig. 2 In-situ Thin Films Process Control System, DigiFamily

3.1 Optical Emission Spectroscopy

OES (Optical Emission Spectroscopy) is an established and universally accepted technique for end point detection and plasma diagnosis. A light emitted from the plasma is characteristic of a process. Useful information on plasma chemical composition, reactive species and contamination can be obtained from this light and allows process control and chamber control to optimize down time, yields and throughput.

Multichannel Optical Emission Spectrometer, the PlasmaScope (Fig. 3) has state of the art optics for superior imaging and spatial resolution. The wide spectral range, 190 to 800 nm, high resolution, down to 1 nm and high sensitivity, 2048 pixels CCD, provide the ideal in-situ monitoring solution for today's shrinking geometries and complex multi-step processes. In addition to this high tech hardware, the PlasmaScope includes many functions for data acquisition, display and processing along with advanced endpoint capabilities such as digital filtering, 3D spectral viewer, mathematical operations, communication protocols, advanced end point algorithms or still equation editor.

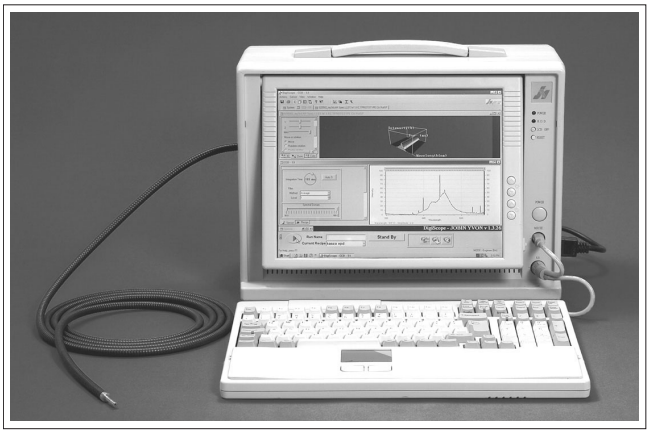

Fig. 3 Multichannel Optical Emission Spectrometer with Advanced Endpoint, PlasmaScope

3.2 Imaging Interferometry

Interferferometry is a powerful technique consisting of illumination of the surface and measuring the reflected intensity from the sample. This technique allows the determination of the etch or deposition rate, the thickness, and the selectivity of the etch process. Both monochromatic, for differential measurements, and spectroscopic, for absolute measurements of the thickness are available. For complex structure with small critical dimensions imaging capability is necessary. A patented system, based on the use an imaging camera, was developed the Multichannel Optical Emission Spectrometer with Advanced Endpoint, DigiLem series (Fig. 4). The system combines a compact interferometer and a CCD sensor for sample observation and spot alignment. Attached to a motorized X-Y table, this system allows patterns recognition. Several fitting methods were developed for the determination of etch/growth rate and film thickness.

Fig. 4 Interferometric Endpojnt Detector and Thin Film Monitor, DigiLem Series

3.3 Polarised Interferometry

Micro ElectroMechanical System (MEMS) is a rapidly growing field driven by micro machined devices and components for automotive, medical and industrial system application. To meet the challenge of manufacturing this generation of devices, precise and novel control techniques are required. Considerable progress has been made during the last few years in the control of deep trench processes, thanks to the sensor technology evolution and the long experience acquired through semiconductor technology. Due to the large features of the MEMS structure (usually higher than 100 μm), the simplest interferometry technique based on a single beam interferometry cannot be used. In order to overcome, this problem, a unique and New Polarimetric method for trench depth monitoring was developed. This new method allows an absolute and accurate trench depth monitoring.

4 Conclusion

In order to be always “One Step Ahead”, the Thin Film Division is continuously heavily investing in R&D. Our research and development projects are always driven by market requirements and customers needs. Our participation to several Framework programs on Research and Technology of the European Union is a further highlight which more and more often results in the development of new technologies.

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