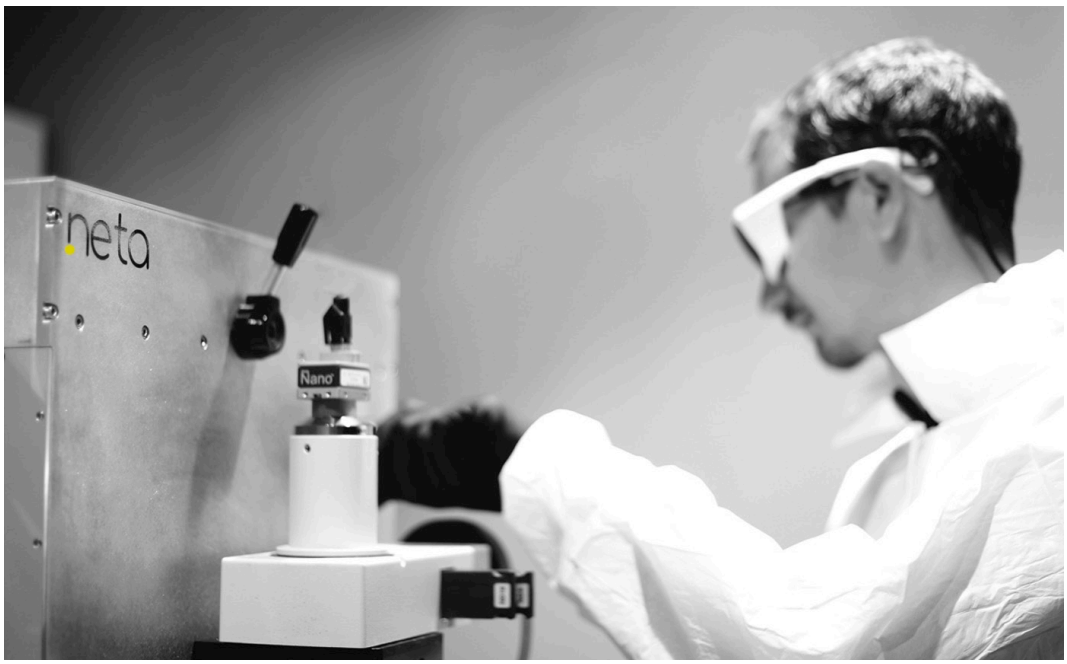
CASE STUDY

Novel technique for measuring and inspecting thin films uses Nikon optics and illumination



Bordeaux company NETA has invented and developed a new and innovative instrument called the JAX. This system is optimized for characterizing thin films non-destructively to a nanometer accuracy. It is the first photo-acoustic imaging system based on asynchronous optical sampling (ASOPS)* and is capable of feeding back measurement data in real time to control film deposition even during complex manufacturing processes.

To help bring the invention out of the laboratory and develop it into a mature product for sale into a wide range of industrial environments, NETA turned to Nikon Metrology for the supply of the illumination module, microscope components and Nikon's high quality CFI60-2 optics. Specifically, each JAX instrument is equipped with a Nikon microscope barrel, sextuple nosepiece, 20x objective lens and an LED epi-illuminator.

In materials science today, the application of thin films in one or more layers is ubiquitous. It is part of the processes used routinely for manufacturing semiconductor components, OLED displays, memory devices, micro-electro mechanical systems (MEMS), biomedical equipment, chemical sensors and much, much more. To characterise their nano-, micro-, and millimeter-scale morphologies and ensure that films have been applied correctly to the base material, numerous mechanical and thermal techniques are available as well as methods involving the impingement and reflection of sub-atomic particles.

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Julien Michelon, President of the French technology company NETA

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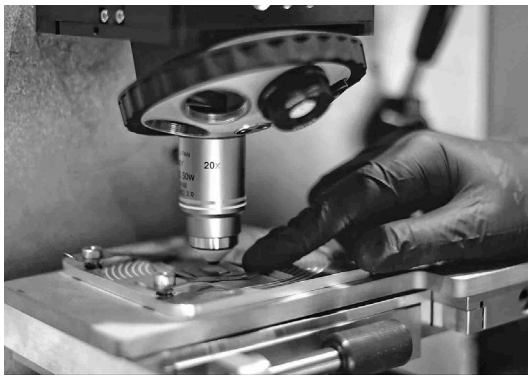
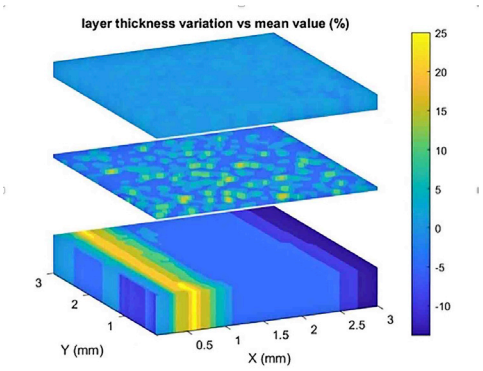


Nikon optics and illumination components used to industrialise NETA's ASOPS photo-acoustic imaging system, JAX, for measuring thin films to nanometer accuracy.



Typical results derived from a thin film using the JAX characterisation system.

The robust, non-contact JAX system sits in the latter category, alongside laser confocal and optical microscopy, electron, ion and X-ray techniques. Now that proof of effectiveness in the technology has been established for thin film measurement and industrial scale deployment is under way, major global players such as manufacturers of electronic chips, screens, solar panels and medical devices have started to take a keen interest. In just a few years, the technology is likely to be routinely found monitoring and controlling production lines globally.

The patented, heterodyne technique directs two synchronised, ultra-fast (100 to 400 femtosecond) pump-probe laser pulses of different wavelength at a sample. An interface with associated software developed in NETA's own R&D department then measures specific parameters reflected as coherent ultrasonic acoustic waves. The film's mechanical and thermal properties can then be fully mapped rapidly, easily and importantly with repeatably to 0.1% for a 5 nm metallic layer, and it is also possible to evaluate layer thickness and efficiency of an adhesion interface.

Julien Michelon, President of NETA commented, "The JAX product we are in the process of industrialising came from a laboratory and was at a very low technology readiness level. Components from various laboratories were being sourced to build very complex assemblies and some useful features of the photo-acoustic technology for measurement and inspection were not being implemented.

"It was due largely to sub-optimal illumination, an inability to change objectives rapidly and an absence of remote control capability. Consequently there was a lack of precision, measurements could be unreliable and not all staff in an electronics production environment would have been able to use the equipment if it had been presented in its original configuration."

He pointed out that as a manufacturer of innovative, non-destructive testing systems, NETA was looking for a supplier that could provide the missing functions that were not part of the company's core business. He wanted to be able to integrate the new features using modular components offering a very high level of quality and performance. The goal, he said, was to produce a turnkey system with maximum functionality to suit all user markets being targeted, and one that actually looks like a finished piece of metrology equipment rather than a work in progress, without sacrificing accuracy and reliability of measurement.

Nikon Metrology was chosen as the preferred supplier of the nosepiece and objective lens as well as the illuminator for three main reasons: the breadth of equipment and components offered in the functional areas that were particularly relevant to NETA's requirements; the attractive price / performance ratio that permitted a cost-effective industrialisation of JAX; and the quality of service support demonstrated and provided by the supplier's engineers, both for the pre-sales advice and then the training after the first units were delivered.

Mr Michelon added, "The Nikon barrel module, for example, allowed us to optimise focus adjustment times by nearly 50 percent. The use of Nikon components has also benefited the general perception of our product as a functional tool, as it now has the appearance of a top-end microscope rather than a black box.

"We have very high hopes for the new JAX system, as not only are we able to target manufacturing organisations in the semiconductor industry, but we will also be able to approach an enormous number of other sectors.

"That is because fabrication techniques exist for preparing virtually any type of material as a thin film, including metals, alloys, oxides, ceramics, glasses, polymers, inorganic complexes, and organic and biological molecules."

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