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Metrology challenges for highly parallel micro-manufacture

Richard Leach, National Physical Laboratory

Abstract

A large range of high-value manufactured parts require structures to be produced over large areas (metres squared) to high resolution (micrometres and below). Examples include the structures for photo-voltaic cells and touch-screen plastic electronics, both of which are manufactured on large polymer substrates in a roll-to-roll process. Such parts present significant metrology challenges due to the high dynamic range of surface topography that needs to be measured. It is relatively simple to measure surface topography over large areas to low resolution (essentially form measurement), or over small areas to high resolution (texture measurement), but the combination leads to very long measurement times and large amounts of data. Also, the type of structures varies significantly, examples being repetitive structures such as micro-optical arrays, or randomly situated defects in large sheets of high-quality paper. To add to these challenges, many measurements need to be performed very quickly and on-line. These metrology challenges will be described along with some ideas of which directions to go to solve them.

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Metrology for in process metrology for roll to roll production of flexible photo voltaics

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Abstract

This presentation reports on the latest development taking place within the EU funded NanoMend project. The aim of the project is to develop integrated process inspection, cleaning, repair and control systems for thin films on flexible photo voltaic films based on CIGS (Copper Indium Gallium Selenide $CuIn_xGa_{(1-x)}Se_2$). Flexible PV films are fabricated on polymer film by the repeated deposition, and patterning, of thin layer materials using roll-to-roll processes, where the whole film is approximately 3um thick prior to final encapsulation. Take up of such devices, especially for building integrated applications BIPV, is hampered by long-term degradation of efficiency due to water ingress through the barrier layer defects to the CIGS modules causing electrical shorts and efficiency drops. To address this problem a thin (~40nm) barrier coating of Al_2O_3 usually provides the environmental protection for the PV cells. The highly conformal aluminium oxide barrier layer is produced by atomic layer deposition (ALD). The presentation reports initial measurement and characterisation of prototype films. Characterisation is based on the application of segmentation analysis and where the film is considered to be a special case structured surface and defects are considered as structural elements. Characterisation then allows the correlation of water vapour transmission with defect density to be addressed. The paper also reports on a new in process, high speed, environmentally robust optical interferometer instrument developed to detect defects on the polymer film during manufacture. These results provide the basis for the development of R2R in process metrology devices.

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Reel to reel production of capacitive touch panels on thin flexible glass

P.T. Rumsby, M-Solv Ltd

Abstract

Equipment and processes have been developed for the manufacture of capacitive touch panels on webs of thin (0.1mm) flexible glass. The equipment incorporates various metrology systems for precision control and monitoring of the substrate tension and position in 2 dimensions. Sensor manufacturing processes include ink jet printing of conducting inks onto the thin glass substrate followed by laser curing, direct write laser ablative fine scale structuring of the printed metal and a transparent conductive coating on the glass and singulation of the sensors from the web by direct UV laser cutting. Off-line metrology systems such as optical microscopy, SEM, white light interferometry, etc are used for set up of these processes. The development of specific on-line metrology systems for process control is now required.

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Precision Surface for Daylighting

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Abstract

Office lighting represents approximately 20% of commercial energy usage. When cooling due to solar heat is included this extends to 40% in some climates. The general pattern of office illumination is to close the blinds and turn on the lights, since workers want to read their screens and prefer a constant, non-glare lighting scheme. The integration of advanced window optics with dimmable, light controlled smart low energy lighting systems can reduce lighting energy needs to a fraction of these current values.

Structured window covering/coatings can be produced which include:

- Micro-optics which redirect light into the interior of the room, tailored to the window aspect
- Diffusers which reduce sun glare
- Active systems which change their opacity and diffusiveness according to the lighting demands

This talk will present designs, technologies and production methods for these advanced window films and discuss their application and benefits.

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