Wavelength Scanning Interferometry for PV Production In-line Metrology

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Abstract

This paper reports on the recent work carried out as part of the EU funded NanoMend project. The project aims to develop integrated process inspection, cleaning, repair and associated metrology systems for the manufacture of large area (450 mm wide), nano-scale thin films of CIGS (Copper Indium Gallium Selenide CuInxGa1-xSe2) based flexible PV substrates.

CIGS thin-film PV modules have created increased interest due to their unlocked potential for high efficiency and low manufacturing costs. However, much effort is required to overcome some obstacles related to the complexity of this technology and its manufacturing process. CIGS thin film solar production requires highly reliable quality control systems during the different production lines. Manufacturers today face a number of technological challenges; micro- and nano-scale defects can appear at any stage of production, resulting in reduced yield and efficiency, as well as reduced product longevity and performance. To date in process metrology of large area substrates has been extremely difficult. The influence of the manufacturing environment, presence of unwanted mechanical vibration especially when measuring flexible thin layers have made embedding measurement within the context of R2R shop floor systems as shown in Figure 1, a limited factor for the manufacturer. Overcoming this limitation by introducing in-line measurement method can effectively improve manufacturing throughput and make cost reductions.

Figure 1: R2R demonstrator / re-winder

This research paper reports on the deployment of in-line interferometric optical technique based on wavelength scanning interferometry (WSI), for detecting PV barriers defects. The instrument has built-in environmental vibration compensation, providing areal measurement at high speed of less than a second per field of view. The technique is being deployed on a demonstrator system at a Roll2Roll production facility as shown in Figure 2. The results show the capability of the WSI to be used as a quality assurance tool in PV production lines, where the results compare favourably with off-line metrology techniques.

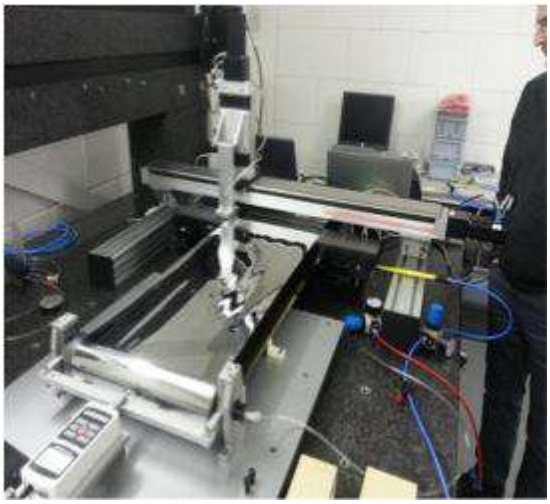

Figure 2: WSI deployed in R2R facility