In-line surface topology process control for printed electronics

In-line measurement of nanometer scale topology features are demonstrated through the combination of a unique interferometer combined with web stabilisation using porous media air tables. ARINNA (Areal Interferometer for Nanoscale Surfaces) provides measurement data in under a second which can be used in-line to improve process and yield performance.

Web stabilization

Laser scribed ITO coated PET webs are to be measured in-line using the interferometer ARINNA; vibrations with an amplitude lower than 10µm (peak to peak) are required for contactless measurement. This stability criteria is achieved using an air table to stabilize the foil moving at speeds from 0.5 to 5m/min (for measurement setup see Fig. 5 overleaf). In Fig.1 and 2. results are shown with and without air table stabilisation at the focal point of the interferometer for three points (S1,S2 and S3) across a 300mm wide web. Maximum measured vibration amplitudeis given for S1, S2 and S3. Results were speed independent.

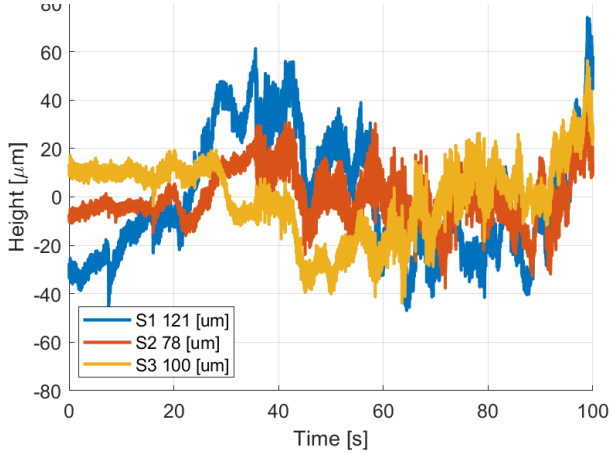

Figure 1. Web stability without air table. With web speed at 5m/min. S1, S2, S3 is the location on the web where S2 is in the center and S1/S3 are on the edges of the web

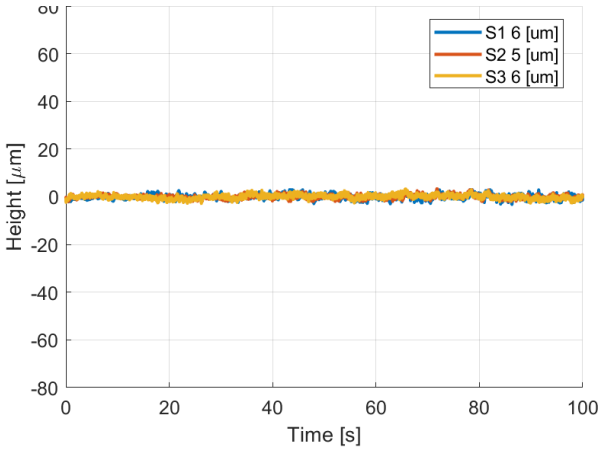

Figure 2. Web stability with air table. With web speed at 5m/min. S1, S2, S3 is the location on the web where S2 is in the center and S1/S3 are on the edges of the web.

Flatness over width of web.

The air table ensures that the web is flattened over the complete width of the foil. The air table employs porous media air bearing regions with vacuum pre-loading. By varying the air pressure and/or vacuum the shape and fly height of the web can be adjusted to achieve optimum flatness. Fig. 3 confirms that at optimal settings, a web height variation <5µm is achieved over 55mm in the web travel direction (see Fig. 5) above the table. In the transverse direction, a flatness <15µm is achieved over 200mm web width i.e. 75nm/mm flatness. For a stationary web vibrations <0.8 µm are measured at a single point at the centre.

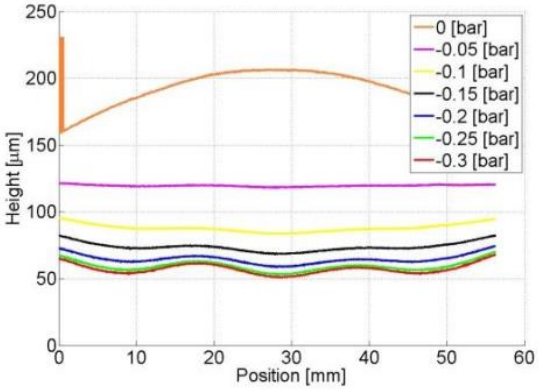

Figure 3. Web flatness over the width of the air table, the length of the web using 2 bar air pressure, 0 to -0.3bar vacuum.

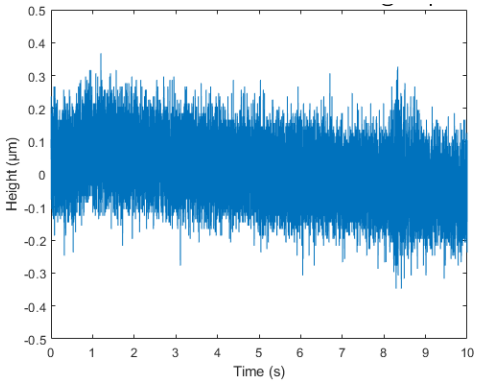

Figure 4. Vibrations on the center of the web. The foil is not moving.

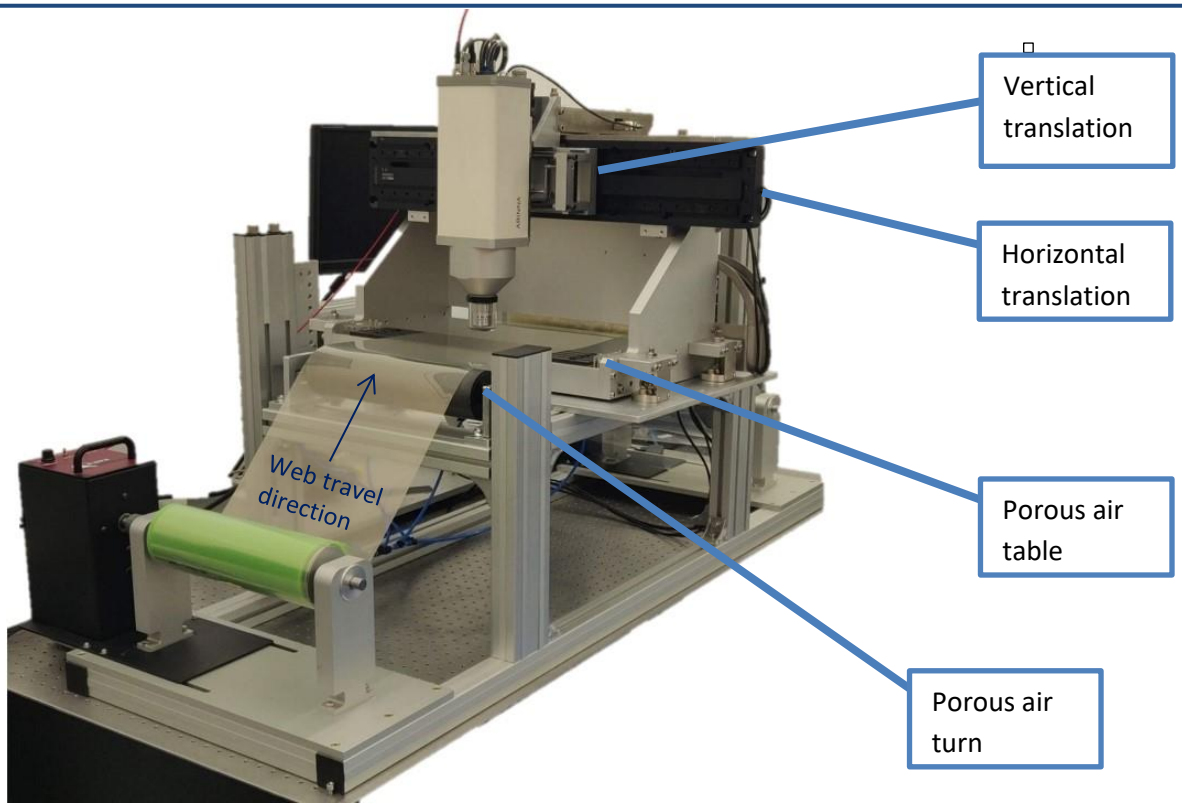

Figure 5. In-line surface topology measurement of transparent printed electronics.

Surface measurement

Successful measurements are made using ARINNA on a transparent and low reflective web in a roll to roll line (see Fig. 5). By stabilizing the foil with an air table it is possible to measure features in the nanometer range. The substrate measured in the figures below is a PET substrate coated with ITO, and laser scribed with scribes of 27µm wide and 100nm deep (Fig. 6).

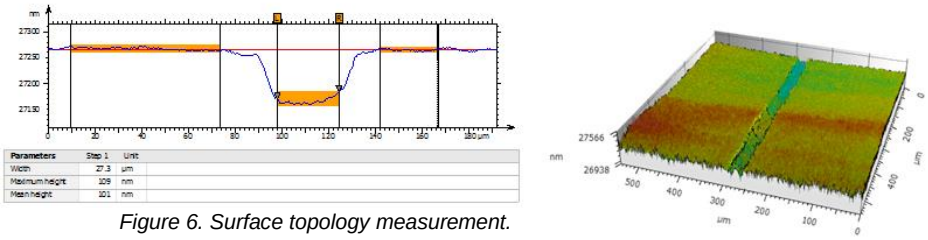

Figure 6. Surface topology measurement.

Conclusion

Air table technology provides stable conditions to perform non-contact surface measurements on an in-line roll to roll setup. Using in-line interferometer, ARINNA, a low reflective transparent web with laser scribed features can be measured without interrupting the process.

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For further details on air tables, air turns (non-contact rollers) or ARINNA please contact:

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