Through VTT, industrial companies and our R&D partners can gain access to the world’s leading roll-to-roll pilot production facilities. The production infrastructure can be used to develop and produce a wide variety of printed components, integrated systems, and complete end products.

Enabling products and business from printed intelligence

The facilities consist of several unique production lines that have been specified and modified by VTT’s R2R printing, monitoring, and production automation specialists. The lines serve versatile customers’ needs in the field of printed intelligence materials, processes, and products. The VTT research scientists and machine operators have extensive hands-on experience and a huge amount of production know-how in bringing developments in the laboratory to roll-to-roll pilot production scale. This unique capability enables VTT to serve its customers in experimenting with and refining a host of material and process combinations while working toward precise specifications for industrial-scale production lines suitable for the specific printed components and end products in question.

Our unique pilot production infrastructure offers our customers and R&D partners access to:

- Skilled and experienced personnel
- Possibilities and ability to modify lines on the basis of specific customer needs
- Availability of diverse printing techniques
- Versatile laboratory facilities
- In-air roll-to-roll printing lines (Figure 1)
- An inert-atmosphere roll-to-roll printing line (Figure 2)
- An roll-to-roll evaporator
- A production control system
- A testing environment for printed components

Combining versatile laboratory and pilot production facilities with skilled research and production personnel enables VTT to develop new material formulations, device structures, and integrated systems – from the first proof-of-concept demonstrator in the laboratory to a roll-to-roll-producible end product. Knowledge of printed intelligence technologies and good relations with industrial partners in the field puts VTT in the unique position of being able to serve and consult its customers by means of the best materials, tools, and manufacturing equipment suppliers in the industry.

The pilot factory can manufacture a wide selection of solidly functional components and products on different substrates by any of the following production methods:

- Reverse and forward gravure printing
- Flexographic printing
- Rotary screen printing
- Slot die coating
- Rotary die cutting
- Lamination
- Hot embossing
- Evaporation
- Etching
Measurements and testing in roll-to-roll environment

In high throughput roll-to-roll processing, web speeds can reach levels of tens of metres per minute. This leads to kilometres of production delivering tens of thousands of units per hour. This factor, combined with the valuable materials being used, creates a high demand for online measurement, testing and quality control, even in research and pilot-phase manufacturing. This need further increases when moving to commercial production.

Optical measurements

VTT has an impressive track record in the development of optical measurement technologies (Figure 3) for continuous manufacturing processes. Previously, VTT has developed real-time quality monitoring and control systems for the pulp and paper, steel, and pharmaceutical industries. These online measurements were mainly based on spectroscopy and machine vision technologies. For printed intelligence, some of these technologies can be directly applied, but there are also some new requirements not needed in other industries. These new challenges include very high accuracy registration, sometimes with layers of very high transparency. Additionally, thin film components like OLEDs and OPV require printed layers of very high homogeneity, without ‘pinholes’ that create short circuits. Layer thickness measurements for these sub-100 nm layers push the boundaries of online optical measuring techniques. Furthermore, the printing quality demands exceed those of graphical printing, so micro-scale online inspection is typically required after each printing unit.

VTT has previously developed and applied various online measurement technologies for these mentioned challenges. As a next step, during 2012, a significant investment will be made to scale up these measurement systems for the new Pilot Factory line. This means the installation of equipment in all printing units, in total more than 10 instruments. This equips the pilot factory as a unique test platform for the online measurements required in printed electronics production.

Functional testing

Even on a short pilot run, thousands of functional devices are typically produced. Manually testing all of these is extremely time-consuming, meaning that full batch testing is not possible. VTT has clarified the testing needs from its wide-ranging layers and components produced within different application areas. According to this information, a new roll-to-roll testing device has been designed and will be installed during 2012. The testing equipment is capable of testing the electrical characteristics of a printed roll, such as conductivity and...
resistivity. It can accommodate and test a 300 mm wide and 200 m long roll within two hours, generating a comprehensive logbook of test data and statistical analysis, such as average values and deviations.

Further developments are also scheduled for upgrading the equipment with additional optical inspection and functional testing capabilities for testing OPVs, OLEDs and ECDs.

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