Breakout Session 5: Continuous Processing/Process Development Needs

Focus question #1E: VISION AND GOALS - In the next five years, what goals would we like to achieve in Continuous Processing/Process Development? What are some of the specific targets we would like to reach? In the future, we would like to be able to .....

- Development of capabilities and materials to enable alignment/imaging of dry/fast dry of multi-layer at STP and air environments on high-speed web at nano, sub-micron and micro scale. Includes deposition/printing of wide range of materials, i.e. functional, passive, active materials.
- Integration of all process steps (pre, during and post); enable sinter within R2R process
- Enable direct deposition/print - R2R/Additive processing of brittle materials,
- 2D to 3D of same and current materials.
- OLED lighting at <$10/kilo lumen, yields at 95% (membranes); overall 2X cost reduction in overcoming “barriers” to scale-up; enable patterning/deposition/print of 50nm structure integrated in R2R
- Enable rapid scale-up from development/prototype to manufacturing, possibly with use of MDF or availability of other pilot facilities to enable demonstration.
- Enabled 100% in-line in-situ inspection (QA/QC) of single and multi-layer builds; Develop and include process control and sensor supportive of fabrication this includes means to ascertain performance of fabricated materials/devices on the R2R line
- Enable flexible, agile, interchangeable process “tools” supportive of small and varying materials type.

Focus question # 2D: CHALLENGES - What are the key challenges/barriers/problems to be solved to continuous processing and process development for R2R applications?

- Lack of material consistency; Development of materials (functional, solvents, fugitives, etc.) which enable compatible continuous builds of multilayer devices; environmentally friendly solvents and reagents.
- New Sensors and analytical equipment supportive of Big Data generation/collection/process/interpretation/process-control in-line with-in a R2R process at all size-scale, especially at the commercial stage.
- Integration of all tools supportive of process within the R2R continuous process
- Development of means to enable modelling of R2R, includes; process/materials characterization, software, etc. Includes full understanding of defect structure on properties, which allow “validated” models – methods – vehicles – metrics = simulation
- Lack of SME and workforce to support advanced R2R scale-up.
- Enabling use of existing “infrastructure” for batch for R2R transition
- Need for next-generation tension/temperature/chemistry/etc. stable webs (polymer, other) to use in R2R equipment

Breakout Session 5: Continuous Processing/Process Development Needs

Focus Question #3D and 3E: R&D NEEDS - : Drawing on the technical challenges identified, what critical R&D is needed to overcome the major challenges, address scalability, and advance new technologies in R2R, in the breakout area?

- In-line/real-time process/quality monitoring/data collect and “Internet of Things”; enhanced non-destructive/non-contact tools to support QA/QC to 10µm (2 years) 1µm (5 years); non-contact sensors for thickness/temperature/etc. and spectroscopic tools enabled to meet process rates in multiple environments (temperature-pressure-atmosphere)
- enable parallel print process to match speeds of webs for sub-micron patterns with supportive metrology/layer-pattern registration and alignment; equipment and process supportive of sub-micron direct-write
- new innovative measurement and modelling tools; modelling of drying; full-characterization of all process steps establishing defect types, predictive modelling and impact on fabricated materials and devices to further enable modelling
- self-leveling materials; develop materials to enhance layer compatibility
- materials in-process which remain stable and homogeneous at elevated temperature
- Means to better drive the overall R2R effort, possibly a network system to enable SME interchange; a workforce knowledgeable in R2R (labor to engineer)

Specific RD topics of interest; In-line Measurement and Control, Sub-Micron Feature Patterning, Modelling, Multi-Materials Systems and Multi-Layers, Rapid (High Quality) Processing, Centralized Expertise and Equipment Resources

Comment of interest: the Equipment Session stressed a need for better understanding of Process and Materials, the Process Session stressed a need for better understanding and capability of supporting R2R equipment. There appears to be a need for enhanced collaboration between all segments of the “supply chain”