

R2R Nanoimprint Process for Multilevel OLED substrate with Transparent Metal Mesh Conductor

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ABSTRACT

Organic LEDs (OLEDs) on flexible substrates offer unique advantages for many lighting applications due to their thinness, flexibility, and potentially low cost. However, the promise of OLED technology in providing a “disruptive” advance for a large segment of the lighting market cannot be realized until several technical and manufacturing barriers are overcome. One structural component that would significantly improve this situation is an integrated substrate capable of both extracting trapped light and providing an improved transparent conductive layer to replace the current problematic anode layer, indium tin oxide (ITO). Key to the success of this approach is the development of a roll-to-roll (R2R) manufacturing technology that can cost-effectively produce this substrate

This presentation describes the design, development and fabrication of an integrated substrate for OLED deposition that provides significantly improved device efficiency. The substrate enables extraction of much of the light (>50%) that is otherwise waveguided and lost in the organic layers of the OLEDs, while also providing high electrical conductivity and improved electrode uniformity for large area devices.

Nanoimprinting is used to form two discrete light extraction layers: an internal surface comprising a periodically textured nanoarray for extraction of waveguide-trapped light based on photonic simulation designs, and a microlens array (μ LA) on the air-substrate surface to extract light trapped by total internal reflection.

Nanoimprinting is also used to form a novel and highly efficient metal nanomesh anode layer that is embedded in and conformal with the internal periodic nanoarray. In addition to eliminating abrupt steps from the metal lines which cause shorting of the OLED layers, the mesh geometry provides >99.5% transparency of the anode layer and features a secondary (field) conductor to produce a continuous, high conductivity transparent layer.

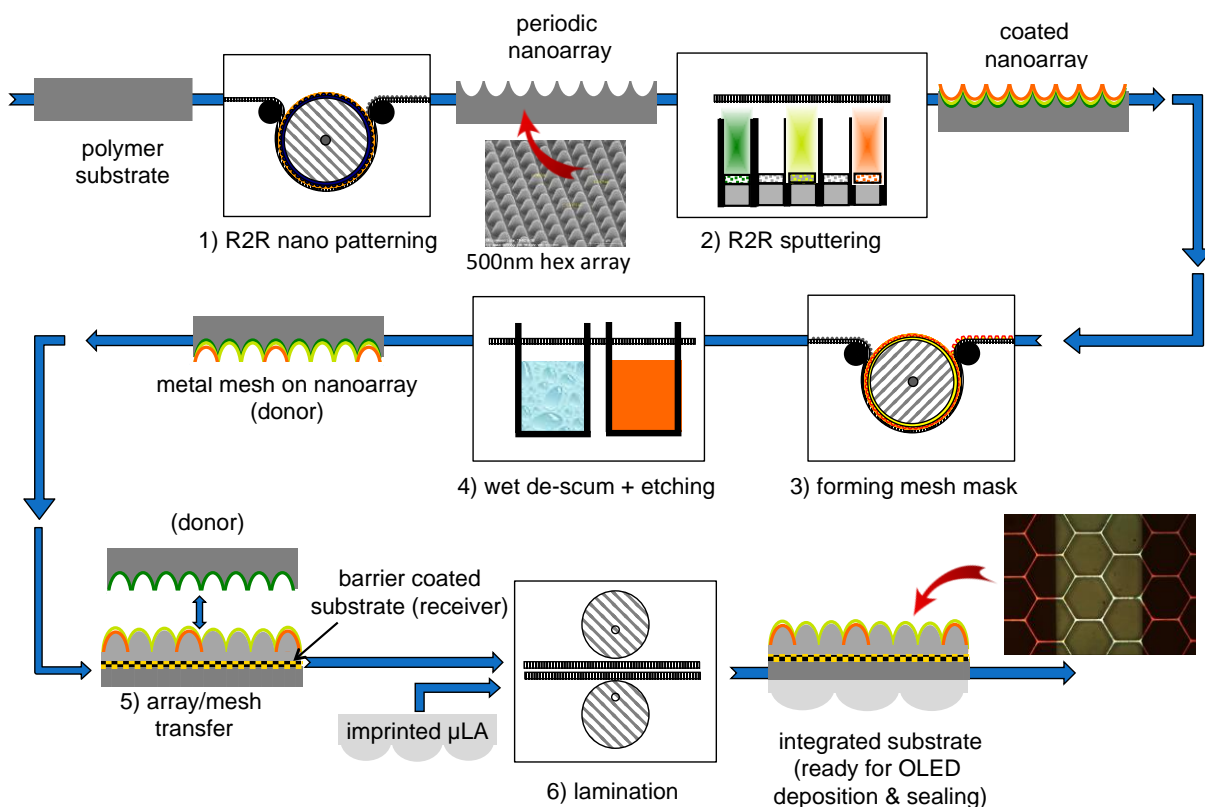


Figure 1. R2R nanopatterning process for manufacturing integrated OLED substrate

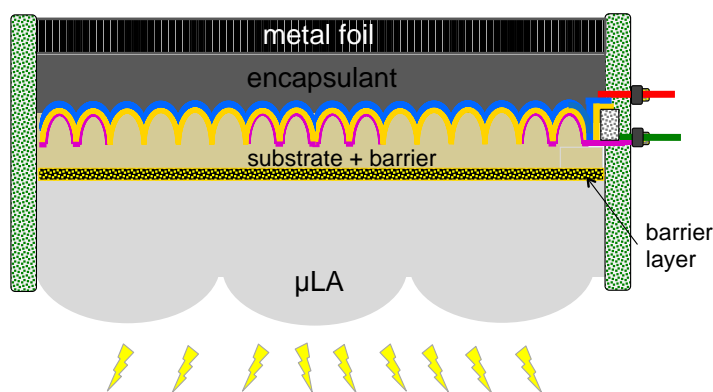


Figure 2. Cross-section of finished OLED on multi-level patterned substrate

References:

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