

Real-time Substrate Transport Control for Stable and Efficient Thin-film-based Roll-to-roll (R2R) Micro-nanomanufacturing

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The commercialization of electronic devices requires the high efficiency and stable micro-nanomanufacturing processes that allow frequent design upgrades. R2R Nano is a gateway to science and engineering research that aims to impact the widespread adoption of R2R technologies for low-cost, high-volume production of high technology products on flexible substrates. However, there are lots of the mechanical and chemical factors influencing the system performance when fabricating nano-scale structures. Thus, feedback control system is increasingly playing a great role in improving the R2R performance.

The aim of the project is to design a feedback control system for enhancing the performance of the R2R system by harmonizing between the moving speed of substrate, film surface energy and substrate's tension. In this project, a roll of thin-film with several microns thickness is used as substrate which allows lower process cost and surface quality but also make the substrate transport more challenging than working with much thicker substrate. The control system design mainly consist several subcomponents such as the thin film substrate tension control, nano-patterned liquid dispenser and real-time feedback controller (LabVIEW programming). As a result, the control scheme will allow fabricating uniform nanostructures over a large area at a desired throughput.

Based on the improved R2R mechanism, multi-processing can be developed such as imprinting, LWD (laser induced direct-writing) and coating. In the experiment, copper nanoparticles will be used as the substrate to test the performance of the system.