

# Roll-to-Roll Reactive Ion Etching Nanoscale Features in Si for Next Generation Flexible Electronics

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## ABSTRACT

Roll-to-Roll (R2R) processing has garnered significant research interest from industry in recent years due to its potential ability to simultaneously address throughput and cost requirements for next generation flexible electronics and the Internet of Things (IoT). However, a complete ecosystem of R2R tools including patterning, deposition, and etch is needed in order to facilitate the transition of device fabrication from wafer-scale to the continuous regime. Many prospective applications also require nanoscale control and repeatability for yield management which necessitates thorough characterization of each process step and an in-depth understanding of the underlying physics of these R2R tools compared to their wafer-scale counterparts particularly during pattern transfer i.e., etching. This work demonstrates progress towards process development and control on an exemplary semiconductor device fabrication scheme utilizing Emerson & Renwick's Genesis R2R platform. Specifically, we successfully demonstrate etching nanoimprinted patterns of nanopillars into Si in a continuous R2R fashion with submicron resolution. Process verification details include quantifying etch uniformity, directionality and material selectivity at varying web speeds. Furthermore, we discuss the systematic characterization of the constituent processes and equipment by intelligent Design of Experiment (DOE) allowing for process parameter tuning to meet desired etch targets

**Keywords:** Reactive Ion Etching, Roll-to-Roll, Process Optimization, Large Area Nanostructures