

# PROCEEDINGS OF SPIE

## ***Alternative Lithographic Technologies II***

**Daniel J. C. Herr**  
*Editor*

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## Introduction

In 2010, the organizing committee redefined and re-scoped the Alternative Lithographic Technologies Conference [ALTC] to focus on evolutionary, revolutionary, and potentially breakthrough patterning technologies. The ALTC also serves as a forum for introducing participants to new and emerging application opportunities. This year's conference placed significant emphasis on novel and emerging techniques that represent potentially extensible patterning solutions beyond the 22-nm technology ITRS technology node. These technology options include, but are not limited to, the ITRS identified non-optical potential solutions, as well as other novel and emerging patterning approaches.

The opening keynote session set the conference's tone, with timely technology updates and overviews on: The application of nano-imprint lithography to the fabrication of storage media (NIL/Albrecht), maskless or direct-write lithography [ML<sup>2</sup>/Platzgummer], and directed self-assembly (DSA/Nealey). Papers on ITRS identified post optical potential patterning solutions and were organized into three sessions each on NIL and ML<sup>2</sup> and two sessions on DSA. Each session highlighted the state-of-the-art and key research and insertion challenges/opportunities specific to the corresponding technology. For the nanoimprint patterning sessions, these included: throughput, template fabrication and lifetime, alignment and overlay, nano-metrology and defects, materials and processes, and emerging application opportunities. The maskless and direct-write patterning sessions explored this technology's status and potential, with respect to the following challenges: throughput, data management, hardware-real estate-software trade-offs, CD and LER control, and material resolution-sensitivity- LER trade-offs. Papers in the two sessions on directed self-assembly provided updates on several ITRS emerging research materials identified performance metrics, i.e. essential shapes, nano-metrology and defects, registration, throughput, CD and LER control, and novel 2D and 3D directed self-assembly concepts. They also described the potential of material and compact models for DSA, design and integration strategies, and novel material families, i.e. other phase segregating materials and molecular scaffolds. Several papers positioned directed self-assembly, not in competition with, but as a tool to augment the performance of existing exposure tool technologies. Participants expressed a significant interest in a directed self-assembly demonstration project to test this technology's potential for IC applications. It also was noted that the first insertion opportunity for these self-assembling materials may be evolutionary, through the development of smart photoresists.

The two Novel Methods and Applications sessions introduced participants to emerging patterning concepts and application opportunities, not comprehended in the ITRS, such as deterministic and bio-mimetic approaches. These sessions also highlighted alternative applications, such as patterned data

storage media, LEDs, sensors, and photonic crystals—since they represent emerging potential entry points for one or more of the conference's alternative patterning technologies. These alternative applications also may provide an incubation environment for these alternative patterning technologies to mature and enable critical infrastructure development, which is necessary for the introduction of a new patterning platform. If successful, each of the considered lithographic and patterning domains could benefit from an improvement in technological capability and reduced manufacturing costs. The last session on cross-cutting technologies provided visibility into the needs and status of strategic patterning topics, such as metrology for nano-scale materials and structures and infrastructure developments for these emerging methods. These last two session themes represent growth venues for this conference.

Finally, I would like to note that several themes from this year's Alternative Lithographic Technologies Conference appeared to have traction with the media. Such initial independent coverage provides useful feedback on participant perceptions of the conference's key messages. The press specifically highlighted directed self-assembly, nanoimprint lithography, and maskless patterning. The following represents a sample article from Dylan McGrath, EE Times, 02/24/2010:

If there is a darling of this year's SPIE Advanced Lithography conference, it just might be directed self-assembly, a technology that emerged in recent years to land on the International Technology Roadmap for Semiconductors (ITRS) and is considered a potential candidate to extend optical lithography. More than 10 papers on the conference schedule are focused on directed self-assembly, a technology that combines lithographically defined substrates and self-assembled polymers. Research has focused on using lithography to alter the surface of a silicon wafer, then adding block co-polymers that assemble themselves into regular arrays along the defined pattern. "This is a long-range lithography technology," said G. Dan Hutcheson, CEO of market research firm VLSI Technology Inc. Researchers see it as a potential path to the sub-10-nm range, Hutcheson said. Directed self-assembly first landed on the ITRS in 2007 as a potential solution for leading-edge, critical layer lithography. The technology is still part of the ITRS as of the 2009 edition.

This article also recognized that while significant progress has been made in directed self-assembly, more development work is needed before this technology warranted insertion consideration for IC manufacturing.

These comments capture some of the dynamics, timeliness, relevance, challenges, and traction from this year's conference topics, presentations, and participants. They suggest that over the next few years, this conference will be the go to event for early awareness of key performance updates, emerging

technology breakthroughs, and new application opportunities. I want to acknowledge my co-chair, Will Tong, and the members of this year's organizing committee for making the 2010 Alternative Lithographic Technologies II conference a success.

I look forward to your participation in and contributions to next year's conference.

**Daniel J. C. Herr**

