Nanoscale Science and Technology Plenary Session
Room 304 - Session NSP-SuA

Nanoscale Science and Technology Plenary Session (ALL-INVITED SESSION)

Moderator: David Czaplewski, Argonne National Laboratory

3:00pm **NSP-SuA-1 Adventures in Nanofabrication and Manufacturing, from Electron-Beam Lithography to DNA: Science, Technology, and Lessons Learned*, James Liddle,*** National Institute of Standards and Technology (NIST) **INVITED**

Over the past three decades, our ability to manipulate and control matter at the nanoscale has advanced dramatically, with investments and progress driven by both the demands of the semiconductor industry and by the potential for nanotechnology to deliver powerful new capabilities in areas as diverse as medicine and energy.While we now have a myriad of nanofabrication techniques at our disposal, determining when and how to implement them in manufacturing is one of the most complex and daunting challenges encountered in research and development.In this talk, I will illustrate the tortuous (and torturous) path from nanofabrication concept to nanomanufacturing implementation through two examples – electron-beam lithography and nucleic acid nanofabrication – taking full advantage of the clarity of vision afforded by hindsight.In both cases, much of the original motivation for research and development came from the desire to solve the *perceived* problem that, in microelectronic manufacturing, ever-diminishing feature sizes would collide with the physical limitations of the incumbent technology – optical lithography – leading to an abrupt end to Moore's Law.As the continued dominance of optical lithography, and its successor, EUV, attest, this analysis was flawed.As I will show, the inability to formulate the correct problem statement, albeit in the context of a rapidly evolving technological environment, led to a number of false starts and dead ends.However, over the course of time, a lot of time, the application areas for which these two technologies are well-suited has come into focus, and much of the knowledge gathered during the course of a stochastic exploration of possible application areas has turned out to be critical in maturing them to the point of manufacturing readiness.Ultimately, the lessons to be learned are that predicting the trajectory of a new technology is not for the faint of heart, and bringing one to market requires constant critical examination of the problem being solved in the context of the competitive landscape, the flexibility to change direction, and unwavering persistence.

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