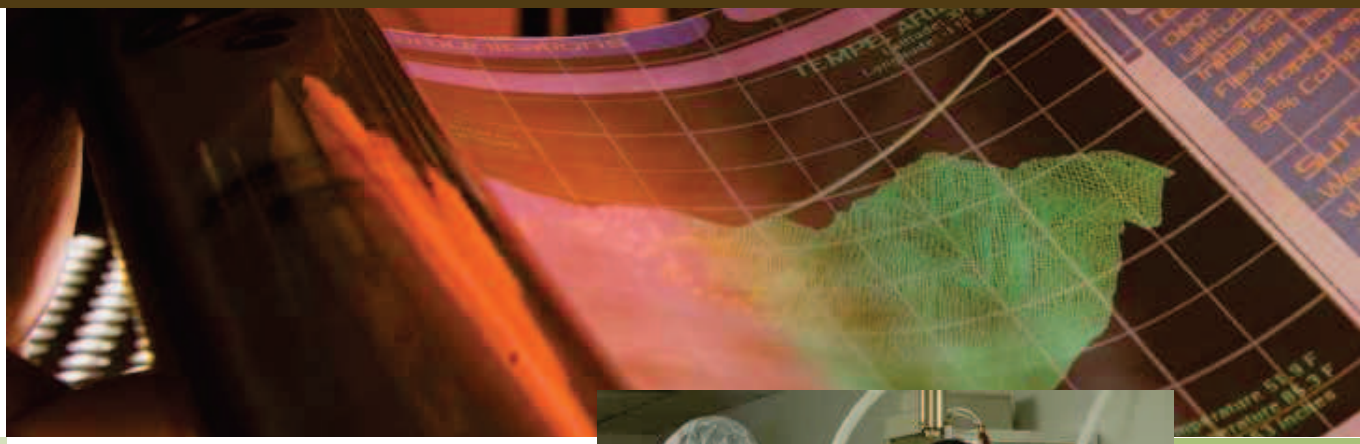
Nanofabrication – Advancing Surface Engineering Methodologies



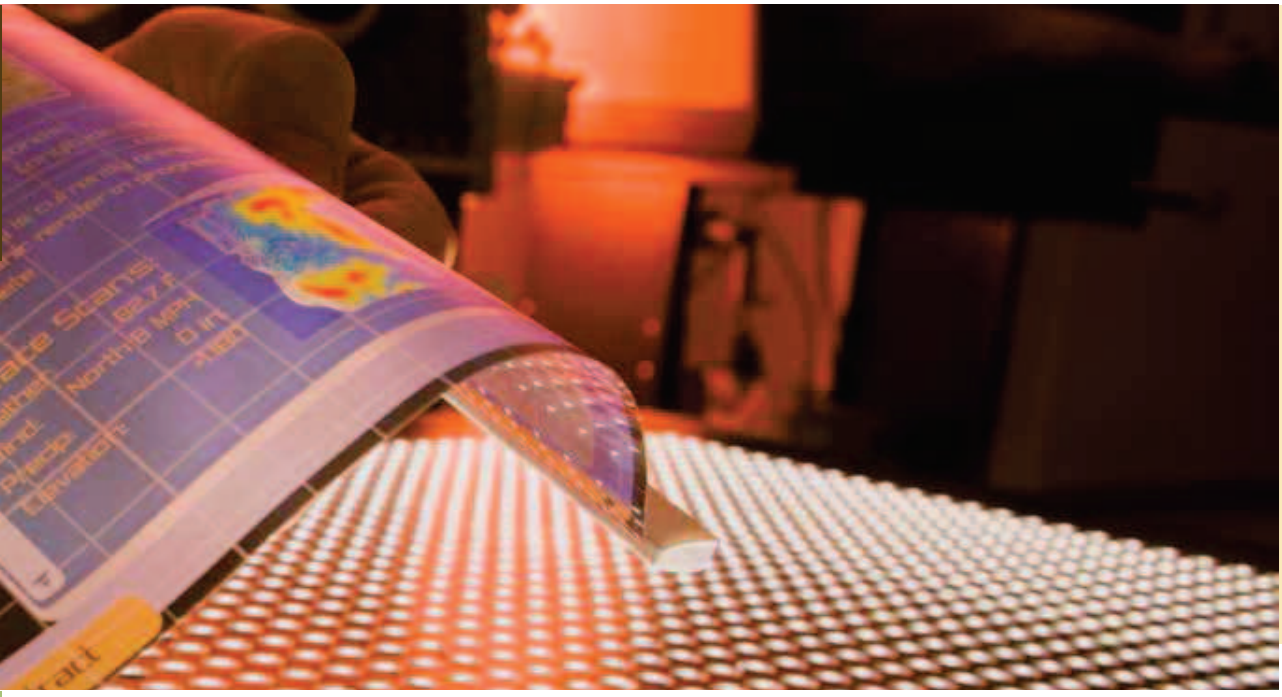
As devices diminish in size, fall in price and decline in energy consumption, the challenges for manufacturing increase. The ability to routinely fabricate devices with high-fidelity nanoscale structure enables us to realise modern integrated circuits, energy harvesting and storage devices, sensors and medical components. Researchers at ASU and DCU have teamed up to further extend our nanofabrication capability and are working on next-generation surface removal processes (etch and deposition) for the precise engineering of surfaces and devices that will underpin the sustainable development of our economies.

The primary focus of the work is on the nanostructuring of silicon surfaces, with the DCU team addressing fundamental issues in gaseous plasma based processing, including plasma-surface interactions, process control and diagnostics, and plasma physics. The ASU team is addressing fundamental questions relating to the evolution of the structure topography on the surface as a function of process parameters and plasma condition.

For integrated circuits in particular, the development of ultra-small dimension devices and interconnects has been based on continual improvement of photolithography. Plasma chemistries and processes have been much less researched. However, the use of reactive ion (plasma) etching to transfer the defined resist pattern to the substrate is becoming ever more critical as feature size decreases due to edge and shape effects, surface chemistry, angular effects and the thickness of the resist layers. It is clear that a detailed understanding of etch and deposition chemistries and methods is now a pre-requisite.

A unique feature of our work is interaction between the plasma chemistry and the surface chemistry. Surface chemistry becomes critical, especially in terms of the modification of surface activity at the high density of edges and interfaces defined by the nanodimensions of the pattern. This nanosurface structure can lead to defects such as undercut and ill-defined shape. Physical topography becomes important due to local trapping of reactive species and even the mechanical strength of the substrate materials and developing topography can be limiting.

This joint project leverages complementary expertise in both universities and has potentially significant impacts on a number of important industry sectors in both Arizona and Ireland, including semiconductor manufacturing, energy systems, and environmental technologies. Additionally, the initiative provides a great opportunity to establish synergies between large research infrastructures and initiatives in both universities, including the Flexible Electronics and Display Center at ASU and the National Centre for Plasma Science and Technology and the newly established Nano-Bio Analytical Research Facility at DCU.



Dr. Gregory Raupp

Director
MacroTechnology Works

Dr. Raupp directs the MacroTechnology Works (MTW) Initiative out of ASU's Office of Knowledge Enterprise Development. MTW drives large-scale, multi-institutional and typically multi-national advanced technology development ventures, with an emphasis on large area and flexible electronics and next-generation electro-optioc devices. Dr. Raupp's technology expertise and professional experience span many disciplines from engineering of microelectronics thin film processes, materials science, manufacturing and product design to ultra-biocompatible implantable medical devices and chemistry of sustainable green processes.

He became the founding director of the Flexible Display Center at ASU in 2004 through a 10-year cooperative agreement with the U.S. Army Research Laboratory. Under Dr. Raupp's leadership, a world-class, industry-government-university partnership model was created, one that enabled organizations with dramatically different missions and scales to collaborate effectively to advance science and technology on a broad front and create a portfolio of enabling commercial manufacturing technologies.

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Dr. Daniels is director of the Sustainable Economies and Societies Research & Enterprise Hub, which drives scientific and social science research, technology development and innovation and supports sustainable development in both industry and the environment. His expertise includes advanced manufacturing, environmental monitoring, water technologies and energy systems.

Dr. Daniels also directs the Energy Design Lab, the Nanomaterials processing lab and the National Centre for Plasma Science & Technology at DCU. His primary research areas cover advanced plasma process control, measurement and diagnostics for IC manufacturing, plasma-enhanced CVD and surface engineering, plasma-based decontamination and sustainable energy systems. As an electronic engineer his experience covers team management and product design and development. He worked for a number of years in the semiconductor industry and has also been responsible for numerous technology start-ups.

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