

# Micro/Nano Technology Center Nano News

## Director's Message

Welcome to an exciting time for the UofL Micro Nano Technology Center (MNTC). During the last year we have greatly expanded our micro/nano processing capabilities to the tune of roughly \$3M. This brings our suite of state-of-the-art processing and characterization tools to approximately \$20M, competitive with most any micro/nano university facility in the world. A brief summary of our expanded capabilities appears below. 2010 is a great time to get involved with the talented MNTC faculty who leverage our core facility. We are always interested in exploring new technologies and interdisciplinary applications. Please plan to stop by and visit our 4 year old, 10,000 sq. ft. cleanroom facility in the near future and meet our newest super hero NANO MAN!

Happy Fabbing,

Dr. Kevin Walsh

## New Processes Update

Spring has been the season for many new pieces of process equipment to come on line. A thermal imaging system and white light interference profiler can be found in the "packaging lab" SRB room 213. The thermal imaging system, aka QFI, allows you to see the temperature of your device and it's components during operation. The interference profiler, aka Zygo, allows one to get a 3D image of their device or surface without the need to make contact.

Down in the Cleanroom of SRB we have a new polyimide curing oven. Those interested in polymer based microstructures know that Oxygen content can play a big part in the polymers final cured properties. This oven will help provide them a consistent product, controlling conductivity, electrical breakdown and film stress. The Cleanroom also has a multi-wavelength laser film stress measurement system, aka Toho, useful for measuring the film stress of nearly any deposited thin film.

## "Molecules to the Max" Premier Party Brings the Red Carpet to the Louisville Science Center

Tuesday, April 13, 2010 by Joseph Lake

On March 31, 2010, the Louisville Science Center, University of Louisville Speed School of Engineering and the Micro/Nano Technology Center hosted an event for the Louisville premier of the IMAX feature, "Molecules to the Max." Although the night did not ring with calls of "Who are you wearing", it did include the introduction of Louisville's newest superhero, NanoMan.



### NanoMan stops for an autograph

This evening event was attended by over 150 Speed faculty, staff and their families. Guests enjoyed an evening in the Science Center with refreshments that culminated in the first public showing of the film to a Louisville audience.

"Molecules to the Max" is a 40 minute animated adventure through the world of Nano, including such eye pleasing spectacles as a trip through a penny at the atomic level and a close up look at DNA. This "stealth education" film is designed to entertain while it informs about the world of the atom.

To see pictures of the premier visit the KyNN Gallery <http://kynanonet.org/gallery/>.

To see the trailer for "Molecules to the Max" visit <http://kynanonet.org/videos/>.

For IMAX show times and more info about the Louisville Science Center visit [www.louisvillescience.org](http://www.louisvillescience.org).

## KyNN Nodes Join Forces With the Louisville Science Center for NanoDays 2010

Tuesday, April 13, 2010 by Joseph Lake

The 2010 NanoDays celebration took place on April 1-3, 2010 at the Louisville Science Center (LSC). This annual event sponsored by NISE (Nanoscale Informal Science Education) network celebrates the nanosciences with educational programs about nanoscale science and engineering and its potential impact on the future.

Approximately 1500 students and visitors from around the state visited the Center during this three day event and enjoyed the demonstrations and hands-on activities provided by several KyNN Nodes. The activities this year at the LSC included liquid nitrogen ice cream, a physics petting zoo, a live video link to researchers at Louisville's Micro/Nano Technology Center cleanroom, alternative energy demonstrations and bunny suit try-ons. KyNN staff members also built a 8 foot diameter buckyball using helium balloons which, to cheers from the visitors below, was hung from the third floor balcony of the Science Center.

This event also served as the launch of the six month run of the nano themed IMAX, "Molecules to the Max."



**KyNN researchers escaped from the lab to share their expertise with the community**

KyNN Nodes that participated in the 2010 event included:

- University of Louisville Institute for Advanced Materials & Renewable Energy
- University of Kentucky Center for Nanoscale Science and Engineering
- University of Kentucky Physics Department
- University of Louisville Micro/Nano Technology Center
- Sullivan University Center for Nanotechnology: Education, Research & Applications
- University of Louisville Department of Bioengineering

NanoDays events are organized at over 200 science museums, research centers and universities across the country every year.

For more information on NanoDays visit their site

For more pictures from the event visit the

<http://kynanonet.org/gallery/> or visit the Louisville Science Center's Facebook page [www.facebook.com/album.php?aid=160239&id=17103251233](http://www.facebook.com/album.php?aid=160239&id=17103251233)



**Mark Crain and Joseph Lake with 8 foot diameter buckyball built using helium balloons.**

## Our Services Include:

### Thin Film Deposition

**Evaporation:** Thermal and e-beam assisted evaporation of Cr, Au, ITO and many other materials on up to 6-in. substrates.

**Sputtering:** RF & DC magnetron sputtering on a variety of substrates: Cr, Au, Ti, W, TiW, Pt, YBCO, ITO and many others.

**Parylene Coating:** Vapor Deposition of Parylene C and Parylene N. Parylene deposition provides the capability to conformally coat dielectric and biocompatible layers on fabricated devices.

**Molecular Vapor Deposition:** Deposition of organic surface coatings used as lubricants, antistiction layers, molecular glues or reactive adhesion layers.

**Electroplating:** MEMS processing for Cr, Au, Cu and Ni using the IKO electroplating system.

### Thermal Processing

**Oxidation and Diffusion:** Thermal processes include wet and dry oxidation and boron and phosphorous diffusion.

**Rapid Thermal Processes (RTP):** For silicon-based gate oxide growth and rapid thermal annealing.

**PECVD:** For depositing nitrides and oxides.

### Lithography

**Photomasks:** 4-, 5- and 6-in. masks with linewidths down to 1.0 micron produced with the Hiedelberg DWL66 laser pattern generator.

**Contact Lithography:** For individual dies to whole 6-in. wafers. Our Suss MA6 and AB-M mask aligners also provide back-to-front alignment capabilities. Nanometer resolution e-beam lithography also available.

**Maskless Lithography:** Intelligent Micro-Patterning SF-100 provides 5  $\mu\text{m}$  linewidth lithography with direct imaging using a DMD.

### Etching and Machining

**Deep Reactive Ion Etch (Silicon):** Silicon DRIE using the Bosch process. Our STS DRIE has pulsed platen bias to minimize "footing" at oxide etch stops.

**Plasma Etching:** RIE systems are capable of providing selective silicon, SiO<sub>2</sub> and Si<sub>3</sub>N<sub>4</sub> etches as well as ashing processes.

**Xenon Difluoride Etching:** Dry anisotropic silicon etching using the Xactix XeF<sub>2</sub> etching system allows for efficient etching of silicon microstructures prone to stiction.

**Anisotropic Silicon Wet Etching:** Extensive experience with KOH, TMAH and EDP wet etchants.

**MicroMilling:** Dover Instruments Ultra-High-Precision Micro Milling Machine is a CNC milling station with nanometer spatial resolution for machining virtually any solid material (i.e., metals, polymers, ceramics, etc.)

**Wafer Level Bonding:** Suss MicroTec SB6 for Si/glass anodic bonding, glass/glass thermal compression bonding and Si/Si fusion bonding.

**Miscellaneous:** Nano-imprinting, micromolding, chemical mechanical polishing, ultrasonic drilling, etc.

### Packaging

**Dicing:** Automated Disco Dicing Saw for silicon, glass and alternative substrate dicing.

**Wire Bonding:** K&S wedge, ball and deep access bonders for aluminum and gold 1-mil wire bonding.

**Flip Chip Packaging:** Finetech Fineplacer "pico" system for die placement up to 5 $\mu\text{m}$ . Can handle SMCs up to 17-mm side length.

**Printed Circuit Boards:** An automated milling system for custom PCB production.

**Lapping and Polishing:** Lapmaster system is capable of thinning a variety of substrates as well as final polishing.



The University of Louisville Micro/NanoTechnology Center (MNTC) provides state-of-the-art fabrication and design services for numerous MEMS, microelectronic, electro-optic and nanotechnology applications. Services begin at the device design level and continue through single-step processing, complete device prototyping and small-scale production. The center encompasses core facilities for micro/nano fabrication, packaging, metrology & test, including a 10,000 sq. ft., 7-bay, class 100/1000 cleanroom. Our wide variety of micro/nano processing tools and 10-plus years of operating experience make our AGI-designed facility popular not only with researchers at UofL and other universities throughout the Ohio Valley region, but with industry and government laboratories nationwide, too. Several multi-million dollar grants from federal agencies support the research carried out in the MNTC including grants from NSF, NIH, DOD, DOE, NASA, and industry. The MNTC is housed in a 120,000 sq. ft. interdisciplinary research building and it allows UofL researchers to use a wide range of equipment and processes to fabricate, package, and test next-generation micro/nano devices and systems. The cleanroom is also a catalyst for start-up businesses and has had a positive impact on the technological economy of the Commonwealth of Kentucky.

For more information on available services contact:

Mark Crain, Cleanroom Manager  
mark.crain@louisville.edu

or

Wendy Metcalf, Administrator  
wsmetc01@louisville.edu  
502.852.8116 Fax: 502.852.8128

Director: Dr. Kevin Walsh, Professor of ECE

Sr. Assoc. Director: Dr. Robert Keynton, Chair and Professor of BE

Assoc. Director: Dr. Shamus McNamara, Assistant Professor of ECE

Don Yeager, Technical Research Services Coordinator

Joseph Lake, Research Engineer/Outreach Coordinator

Curtis McKenna, Photo Mask Coordinator

Tommy Roussel, TCAD Coordinator

Scott Cambron, Post-Processing Coordinator

Doug Jackson, Test/Research Engineer

Editor: Wendy Metcalf - [wsmetc01@louisville.edu](mailto:wsmetc01@louisville.edu)

## MNTC Faculty

### Chemistry

Richard Baldwin  
Francis Zamborini

### Physics

Sergio Mendes  
Gamini Sumanasekera

### Bio Engineering

Andrea Gobin  
Robert Keynton  
Palaniappan Sethu

### Chemical Engineering

Xiao-An Fu

### Electrical & Computer

### Engineering

Bruce Alphenaar  
Robert Cohn  
Cindy Harnett  
Shamus McNamara  
John Naber  
Kevin Walsh

### Mechanical Engineering

Thomas Berfield  
Roger D. Bradshaw  
Balaji Panchapakesan  
Stuart Williams

University of Louisville  
Micro/NanoTechnology  
Center



Innovation Through  
Miniaturization



<http://louisville.edu/micronano>