Integrated Micro/Nanosystems for Communications and Biomedicine

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UCI Integrated Nanosystems Research Facility
Engineering the Microworld at The University of California, Irvine

UCIrvine

California Institute for Telecommunications and Information Technology

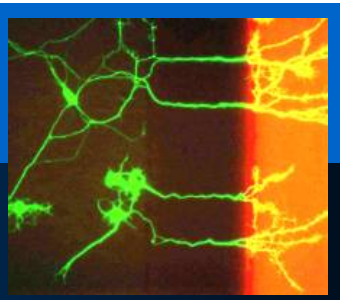
University of California, Irvine

- 1,500 acres for academic core, institutes, housing, Research Park – *a UC growth campus*
- Annual budget: $1 billion
- Students: 24,874
  - 20,133 undergraduate students
  - 4,741 graduate students
- Employees: 15,796
  - 1,493 faculty
  - 10,934 academic & non-academic staff
  - 3,369 Medical Center

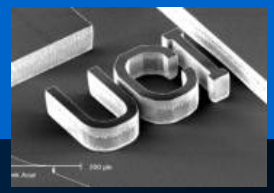
Planned UCI Growth by 2010

- Students: Growth to 28,000 (to maximum of 32,000 with 7,000 graduate students)
- Faculty: Increase by 500+ new faculty to a total of 1,900
- $600+ million of new research buildings
- University Research Park build-out to 2.4 M sq. ft., 60 firms & 10,000 employees

Select UCI Research Units



- ***Beckman Laser Institute (BLI)***
- ***California Institute for Telecommunications and Information Technology (Calit2)***
- **Cancer Research Institute**
- ***Center for Biomedical Engineering***
- ***Center for Embedded Computer Systems (CECS)***
- **Center for Molecular & Mitochondrial Medicine & Genetics (MAMMAG)**
- **Center for Neurobiology of Learning and Memory**
- ***Center for Pervasive Communications and Computing (CPCC)***
- ***Center for Research on Information Technology and Organizations (CRITO)***
- **Genetic Epidemiology Research Institute (GERI)**
- **Institute for Brain Aging and Dementia**
- ***Institute for Genomics and Bioinformatics (IGB)***
- **Institute for Software Research (ISR)**
- **Institute for Surface and Interface Science (ISIS)**



Select UCI Research Facilities

- Biotechnology Resource Facility
- Confocal Microscopy
- High Throughput BioRobotics
- Imaging Center
- Infrastructure Array of Enhanced Nodes Supercomputer
- *Integrated Nanosystems Research Facility*
- Microarray Facilities
- Model Compound Library
- Molecular Modeling
- NMR
- Parallel/Automated Synthesis Laboratory
- Protein Expression Facility
- Protein Laser & Mass Spectrometry
- Software Synthesis Laboratory
- Spectroscopy
- Transgenic Mouse Facility
- UCI Arboretum
- Video/3-D Imaging
- Viral Vector Center
- X-Ray Crystallography

INRF Research Facility

- State-of-the-art research facility developing integrated micro/nanoscale systems
- Educating and training future multi-disciplinary scientists and engineers

I-line Stepper with
0.35 μm resolution

E-beam
Lithography

Deep Reactive Ion Etcher
for bulk micromachining

Low-temp (<100ºC)
PECVD of SiN

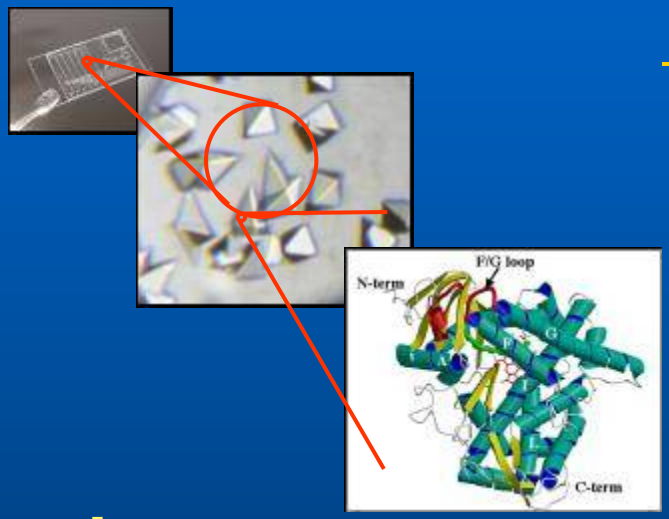
UCI Integrated Nanosystems Research Facility

Engineering the Microworld at The University of California, Irvine

People

Education through innovation

- 38 faculty,12 departments
- 122 graduate users
- 39 undergraduate users
- 22 postdoc users
- 63 industry users, 25 companies
- Experienced technical staff



Ideas

From atoms to applications

- Nanotechnology
- Biomedical / life science
- Wireless communications
- Optical systems

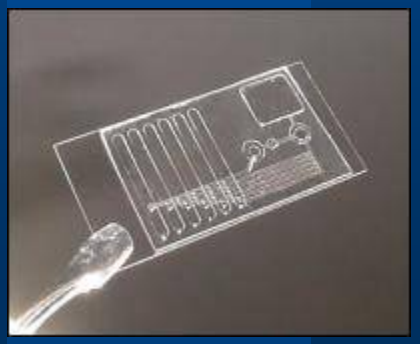
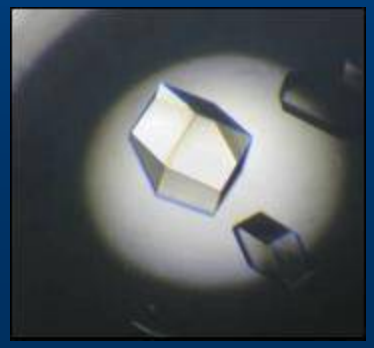
Resources

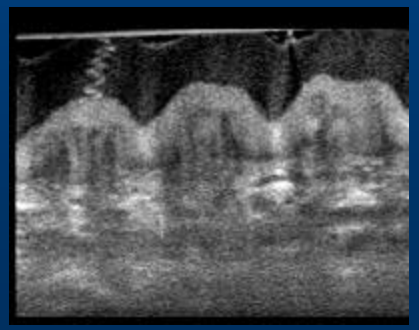
Empowering multidisciplinary innovations

- 8600 sq.ft. clean room, class 10,000/1,000/100
- SEM/TEM capabilities
- Optical lithography to 0.3 um
- Electron beam lithography
- CVD for nanotube growth
- Metal deposition
- PECVD, RIE, ICP, DRIE
- Polymer MEMS capability

INRF Technology Roadmap

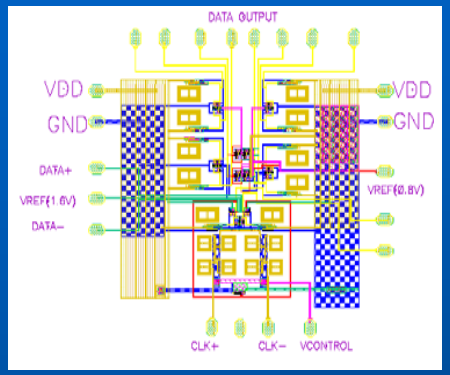
- INRF “holistic” approach to micro/nano systems
  - *System level design at the fabrication level*
- Integration of non-semiconductor technologies with micro/nano fabrication techniques
  - *Technology integration at the manufacturing level*
- Implementation of multi-function systems in the field
  - *End-user application integration*

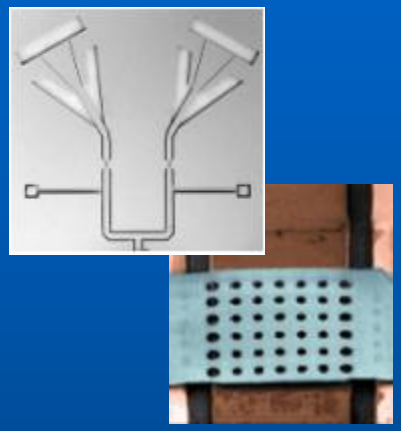


INRF Research Thrust Areas

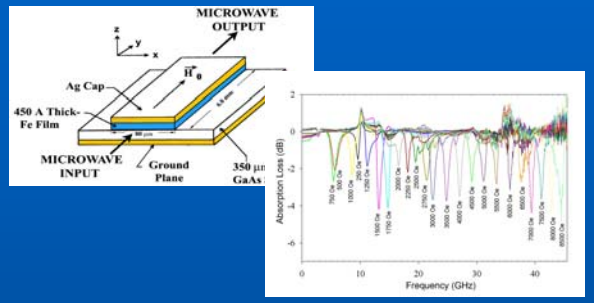
RF and wireless communications



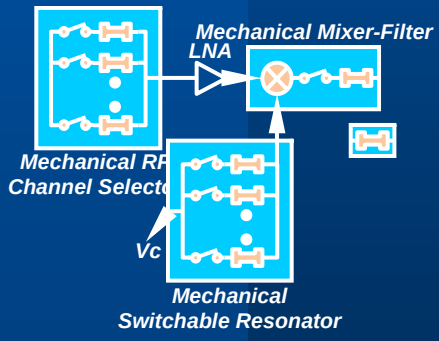
High-speed RF mixed-signal circuit design



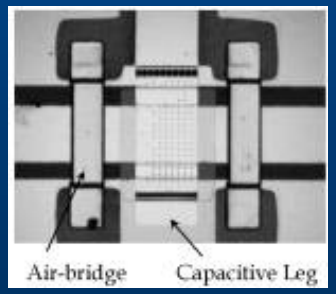
Reconfigurable antennas with integrated RF MEMS switches



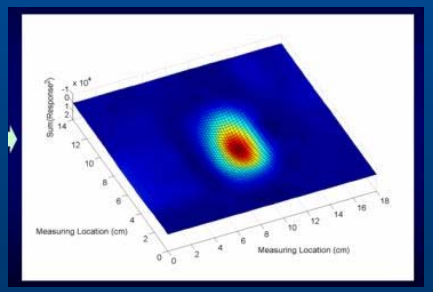
Fe-GaAs integrated wideband microwave devices



MEMS-based ultra-low-power RF receivers



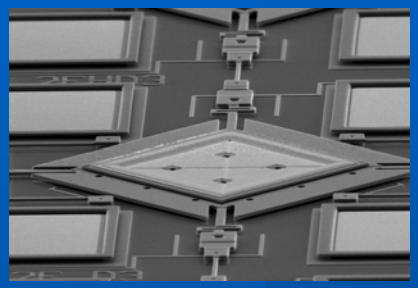
Tunable capacitive switches



Microwave imaging for damage assessment of structures

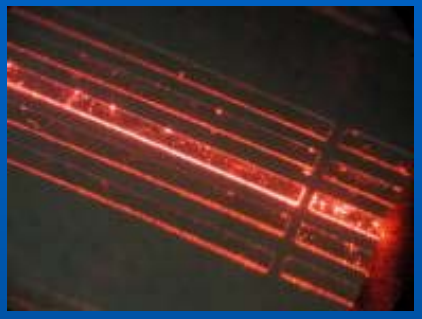
INRF Research Thrust Areas

Optical systems



Micro mirrors for tissue scanning and tunable Fabry-Perot interferometers

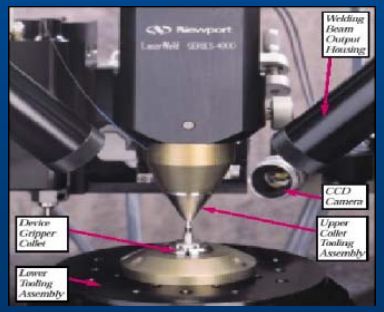
Polymer waveguides, polarization controllers and other electro-optical devices



Optical resonant beams for acoustic sensors

All-fiber tunable devices, including acousto-optic tunable filters

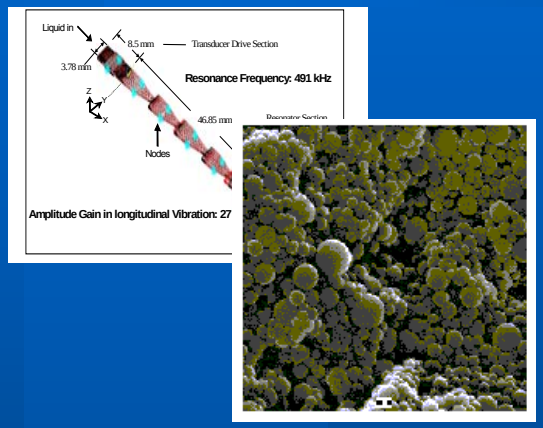
Polymer etalons



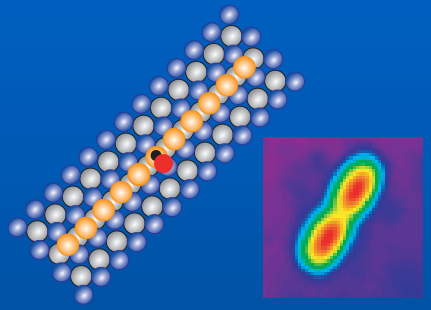
Intelligent fiber-optic alignment algorithms

INRF Research Thrust Areas

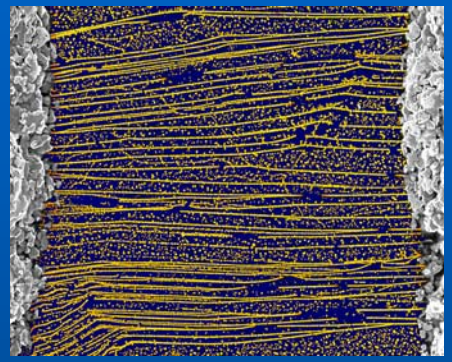
Nanotechnology / nanofabrication



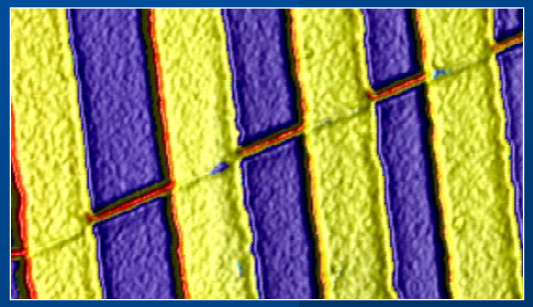
Spray atomization of nano powders using MEMS nozzles



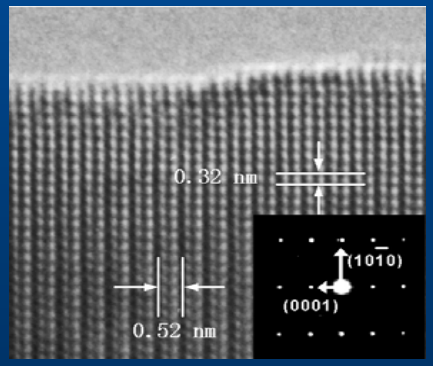
Single molecule detection



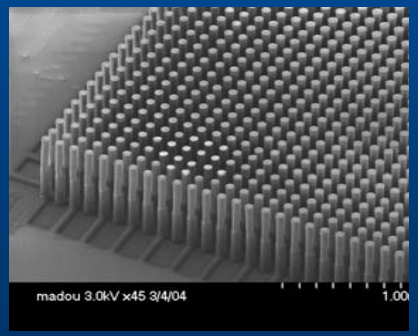
New methods for making arrays of nanowires



Carbon nanotubes for sensor and electronic applications



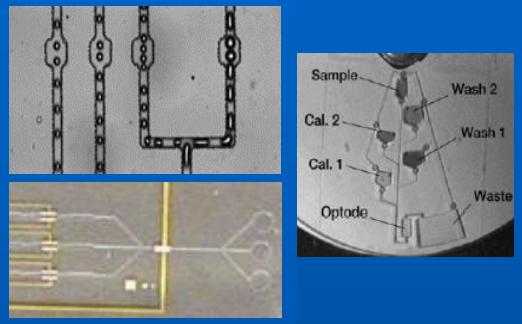
ZnO nanowires for chemical and polarization sensing



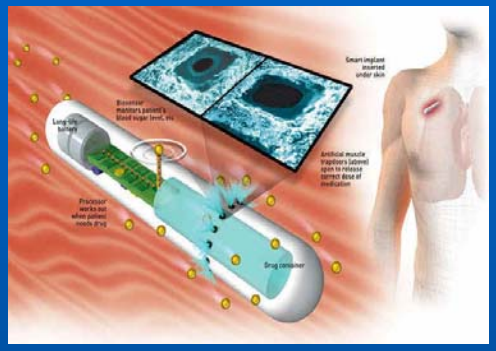
Carbon posts for miniaturized batteries

INRF Research Thrust Areas

BioMEMS and other medical applications

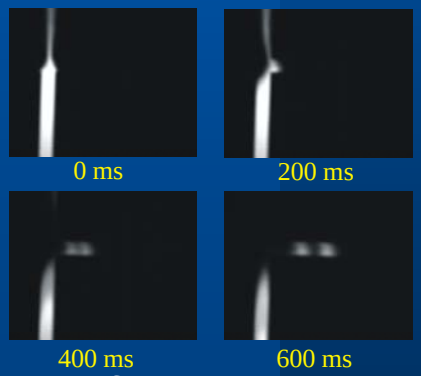


Microfluidic devices using droplets, CD microfluidics and magnetohydrodynamics



Implantable drug delivery pills

Micromirror on a catheter for optical biopsy using coherence tomography



Microfluidic devices for electrophoretic separations

Strain sensors for orthopedics

Protein crystallization in nanovolumes

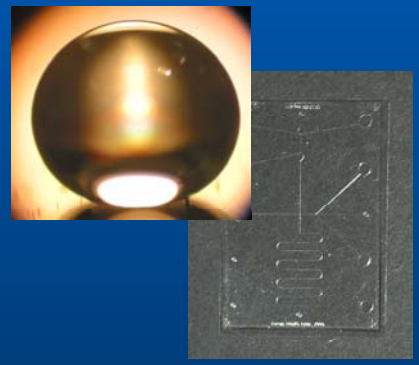
Academic Institutions as Sources of Discovery

Universities have a traditional role of science discovery, but are also increasingly being asked to take a bigger role in development

- Decline of R&D efforts by large companies
- Industry interested in picking “winners”

Micro and Nanotechnologies

- Defined by new phenomena at small scale
- Characterized by the need to integrate components at the start of the development
  - Necessity for interdisciplinary collaboration
  - Involvement of scientists and engineers across disciplines



Microfluidic devices with tailored surface characteristics and integrated electronics

Academic Institutions and Technology

Universities recognize value of technologies, but difficult for tech transfer offices to pick winners

Most universities' licensing income comes from < 5% of their patent portfolio

UCI TECHNOLOGY ALLIANCES

Additional value of the tech transfer process is in commercialization of technology and subsequent success of the company

- Research contracts with faculty
- Hiring of trained graduate students
- Individual benefactors and grateful alumni

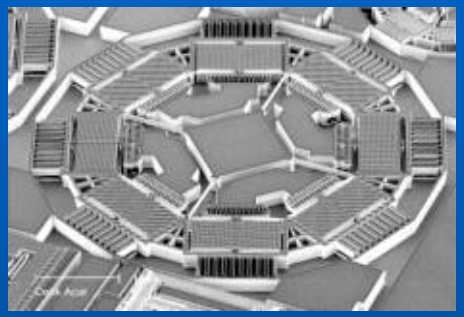
Engineering the Future at UCIrvine

The Henry Samueli School of Engineering
University of California - Irvine

Two Paths for Commercialization of New Technologies

Licensing

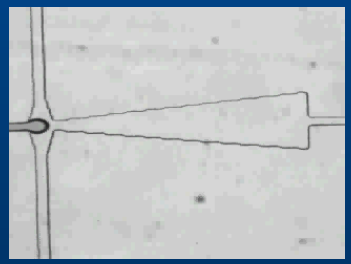
- Large companies review universities' portfolios – look for fit
- Small companies partner with faculty to leverage university resources
- Entrepreneurs see the commercialization potential of a technology



Si-MEMS gyroscope: *Winner of worldwide MEMS design competition*

Spin-offs

- Faculty mostly remain at the university
  - Interested in developing new technologies rather than focusing on just one
- Spin-offs often start with participation of former graduate students and post-docs



Droplets < 1 nL
High-speed camera

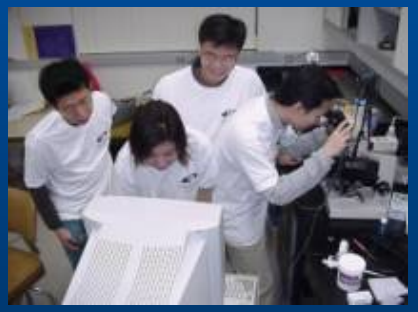
Academic Role in Commercializing Nascent Technologies

- Developing technology
- Generating IP
  Without patents, there would be no protection
- Technical resources
  Collaborations with faculty through funded projects, consulting, and use of shared lab space
- Other resources
  Access to other campus entities (e.g., Center for Entrepreneurship)
  Contacts to funding sources and industry

California Institute for Telecommunication and Information Technology – Calit2

- Developing applications in
  - Intelligent Transportation and Telematics
  - Environment and Civil Infrastructure
  - Digitally Enabled Genomic Medicine
  - New Media Arts

- Application labs in thrust areas
  - Micro and nanofabrication
  - Material Characterization
  - BioMEMS
  - RF/wireless
  - Fiberoptics
  - Visualization
  - Networked infrastructure



UCI Involvement in Regional Efforts

- Collaboration with Orange County Technology Action Network (OCTANe), including OCTANe@UCI, a showcase for UCI technologies
  www.octaneoc.org
- 2nd SoCal Tech Transfer (T2) Conference in collaboration with LARTA
  http://www.larta.org/T2/
- Involvement with local technical, business, and VC community
  - Orange County Venture Group (OCVG)
  - Life Sciences Industry Council (LINC)
  - Tech Coast Venture Network (TCVN)
  - TBC (TechBizConnection)

OCTANe

Larta

PROJECT T2

A TECHNOLOGY TRANSFER CONFERENCE