NanoFabrication Kingston

People. Ideas. Technologies.

Queen's University

NanoFabrication Kingston

Seminar and Webinar

January 31, 2017

Rob Knobel – Associate Professor, Dept. of Physics

Queen's University

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What is NFK?

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It's a place, an team of experts and a service.

The goal of the facility is to help academic researchers and companies explore materials and devices at a scale down to nanometres, where materials behave differently and offer new technological opportunities.

No other open-access facility in the region offers the types of fabrication and characterization capability found at NFK. Researchers or companies can bring their problem or idea to the lab, and either be trained to operate the equipment themselves, or contract with the lab to have it done for them.

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Nanotechnology

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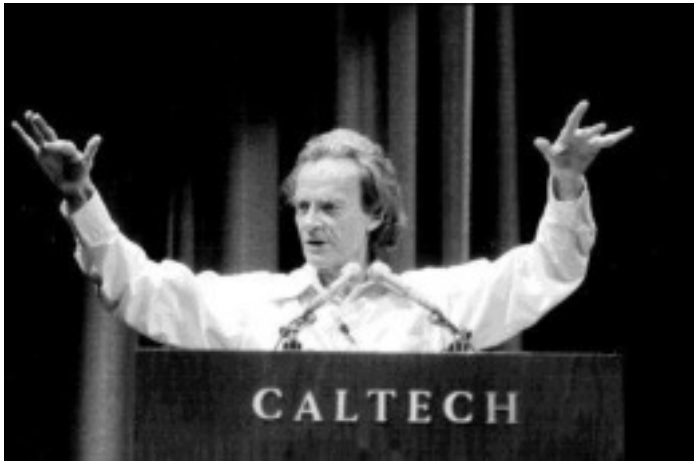
One way to define the beginning of nanotechnology is the American Physical Society meeting in 1959. Richard Feynman gave his famous speech "There's Plenty of Room at the Bottom":

"I would like to describe a field, in which little has been done, but in which an enormous amount can be done in principle.

What I want to talk about is the problem of manipulating and controlling things on a small scale."



"Why cannot we write the entire 24 volumes of the Encyclopedia Brittanica on the head of a pin?"

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The semiconductor industry's ideas

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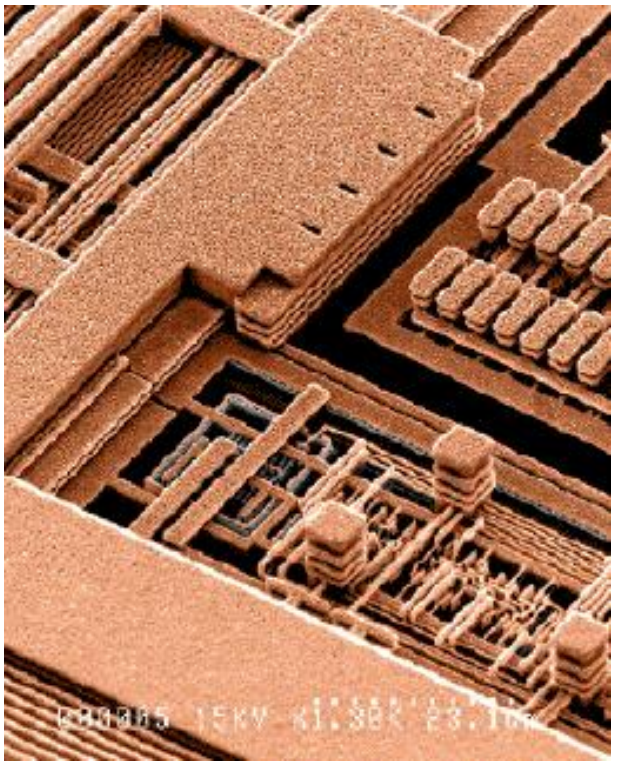
The semiconductor industry has developed tools to make transistors and connectors with few-nanometer resolution.
We can now machine structures with few nanometer precision in (almost) arbitrary shapes using these "top-down" fabrication techniques.

But we can also exploit this technology and make machines, chemical plants, sensors, instruments using this technology that its inventors never envisioned.



IBM copper process, 1998

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Microsystems and Nanosystems

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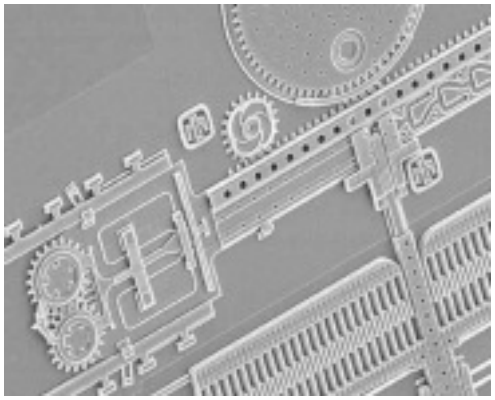
For the past ~25 years we've been using and modifying the techniques of the semiconductor industry to make new devices – smaller, faster versions of macroscopic devices. And making some things that just can't be done at a larger scale:



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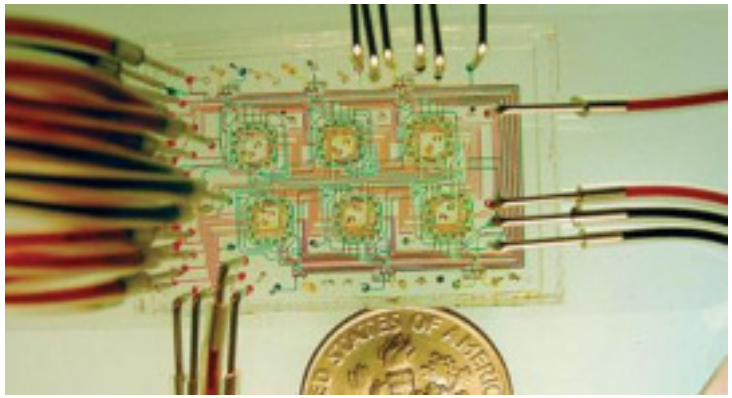
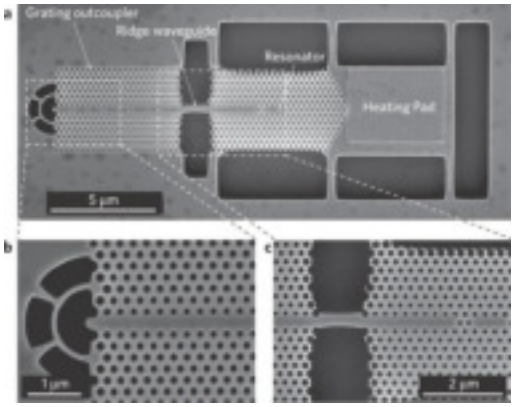


Microfluidics



Photonics

Not just electronics!

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Processes

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Much of what our community needs isn't a full process like this – more often we just need a few steps of a process:

- Deposit a thin layer of material
- Image and characterize some tiny structure
- Create a pattern of wire or channels smaller than a mm in size
- Chemically modify a surface

Each of these steps forms part of an experiment or innovation – but can be hard for companies or researchers to do without expensive, complicated, and specialized tools or training.

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What is NFK?

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The Kingston NanoFabrication Laboratory (KNFL) opened 2 years ago after over 5 years of planning and construction. With funding from Canada Foundation for Innovation (CFI), the government of Ontario, Queen's University and CMC Microsystems we put together a partnership, a lab, equipment and an expert team to help the community.

This month we've rebranded the facility as NanoFabrication Kingston and expanded the tools and capabilities. This seminar will help explain what's new.

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The space

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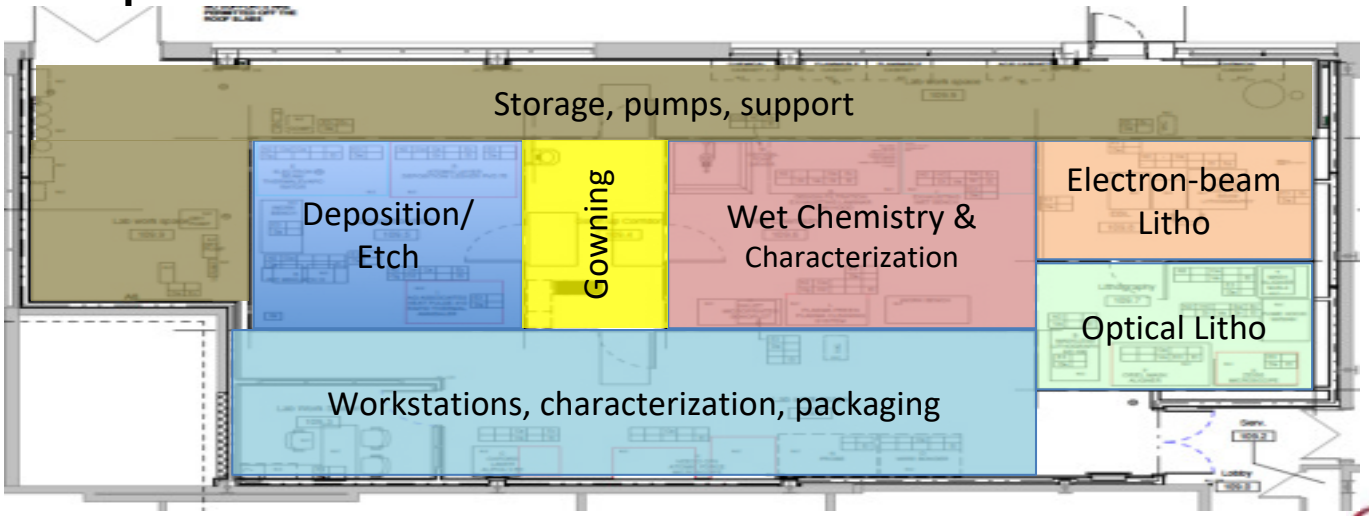
- 1500 square feet of clean room space, 3000 square foot total lab at Innovation Park
- $2 million renovation, $2.3 million in new tools, $1+ million in existing tools
- New $1 million grant brings new patterning, etch and deposition tools



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An Open Lab

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The lab has been conceived, designed and is operated as an open environment:

Anyone (academic, industrial, government) can come and use the equipment and get support to achieve your research and development goals.

In many cases YOU (or your students/employees) will have hands on access to the equipment. NFK staff provide extensive training and support to ensure success.

In other cases, you might want NFK staff to do the work for you. This fee for service model is also available.

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Academic/Not-for-Profit Partnership

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A unique partnership between Queen's and CMC Microsystems to jointly deliver shared tools, an accessible environment, high quality training, and successful outcomes.

CMC provides day-to-day lab operations support, Queen's supplies the equipment and space, and together Queen's and CMC guide the lab and seek internal and external users.

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Management

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NFK is a partnership between Queen's University and CMC Microsystems. CMC is a Canadian not-for-profit organization that enables micro-nano research in Canada, and are operating the lab.

At NFK, CMC offers in-house expertise for:

- Lab training
- Design consultation
- Project services

Supported by user fees, subsidized by government grants

Financial assistance for fabrication projects is available!

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Capabilities

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NFK has a suite of tools covering a variety of micro/nano research needs:

Cleanrooms
- Fume hoods for clean processing

Lithography
- Conventional photolithography (1-2 μm)
- Maskless lithography (500 nm)
- Electron-beam lithography (20 nm)

Etching
- Wet chemical etching
- Inductively coupled reactive ion etching

Deposition
- Spin coating
- Electron-beam physical vapour deposition (e.g. Al, Cr, Au, Ag)
- Sputter physical vapour deposition
- Ultrasonic inkjet microplotter

Machining
- Laser micromachining
- 3D printing (soon)

Characterization
- Optical microscopy
- Scanning electron microscopy
- Probe station

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New Tools

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A new suite of tools were installed in late 2016 as part of a second CFI grant led by Profs. Nunzi, Barz and Stotz: "Portable multidimensional micro-nano biological sensing devices"

Trion minilock ICP etcher: allows selective dry etching of insulators, metals and semiconductors with straight sidewalls.

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- Neutronix-Quintel Mask aligner: allows user-friendly transfer of ~1 micron patterns onto wafers up to 6 inches in diameter.

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Kurt Lesker PVD 75
Dc + rf sputter deposition system. Allows controlled deposition of pure and alloyed metals and insulators.

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A central hub for nano

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We want NFK to be more than a room with tools. By working with facilities across campus, across Kingston and across Canada through CMC's network we can facilitate your use of state-of-the art tools and world-leading expertise.

If you have expertise and equipment you are willing to share, or want to do something that hasn't been listed – let us know and we can work with you to exploit the network.

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People and ideas

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NFK's biggest strength is its team. We strive to train users, to bring research and development success, and to grow the capabilities. Talk to us!

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