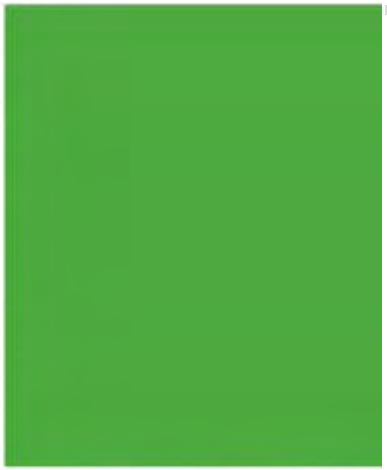


micralyne

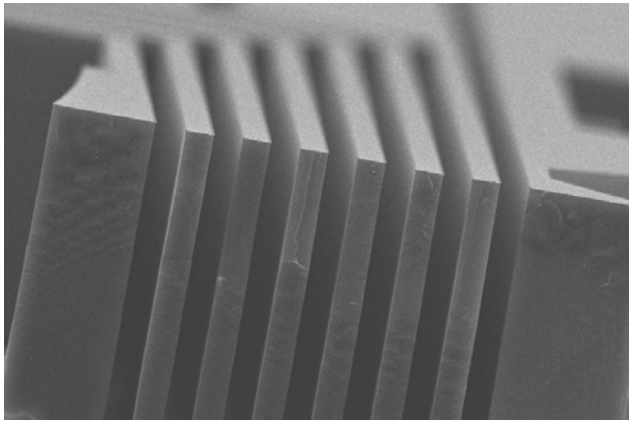
Bringing Your MEMS to Market

MEMS 101

An Introduction to Micralyne and MEMS

What are MEMS?

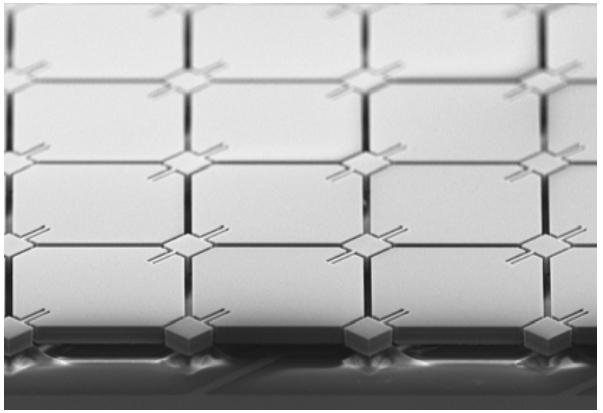
MEMS (Micro-Electro-Mechanical-Systems) are components that have feature sizes in the scale of microns. MEMS devices commonly have both a sensing and actuation element.



1000 microns
=
1 millimetre

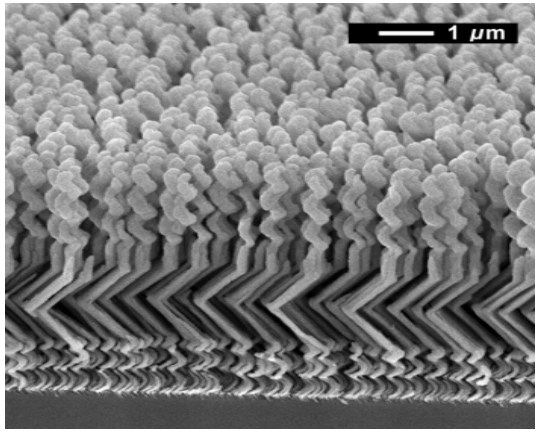
What are MEMS?

- MEMS are miniaturized, moving components
- Allows instrumentation to be smaller, faster, and less expensive
- Manufactured using semiconductor process technology, similar to an Intel chip
- Cost advantages of batch (high volume) manufacturing technologies



What is Nanotechnology?

Nanotechnology relates to <100 nanometre structures with an element of self-assembly



1000 nanometres
=
1 micron

– 1 nanometre is one one-billionth of a metre
– Fundamental changes in manufacturing methods
– World-class institution here with National Institute for Nanotechnology (NINT) at the U of A

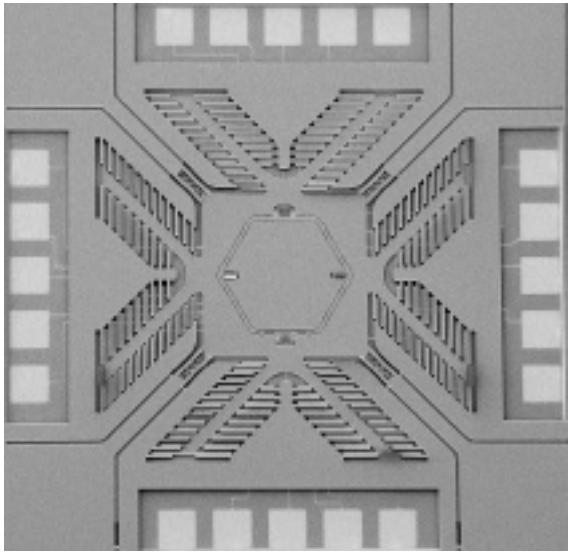
Why use MEMS?

The MEMS Business Case:

Size – seeking a smaller footprint

Performance – looking for an exponential improvement

Cost – striving for lower costs through batch processing



History of MEMS

- The invention of the transistor at Bell Telephone Laboratories in 1947 sparked the fast-growing microelectronic technology industry
- Jack Kilby of Texas Instruments built the first integrated circuit (IC) in 1958 using germanium (Ge) devices
- Since 1970, the complexity of ICs has doubled every two to three years
- The first high-volume pressure sensor was marketed by National Semiconductor in 1974 - it included a temperature controller for constant-temperature operation
- Around 1982, the term *micromachining* came into use to designate the fabrication of moving micromechanical parts

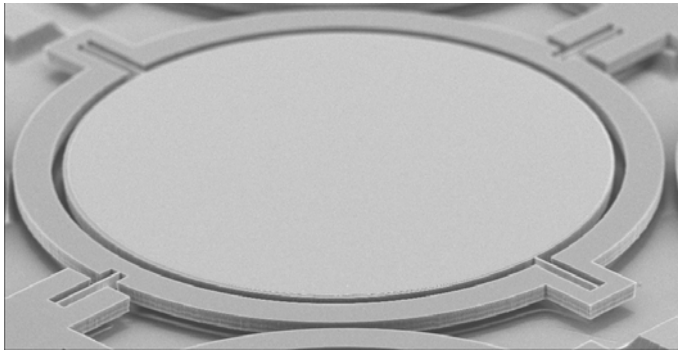
History of MEMS

- The micromechanical parts were fabricated by selectively etching areas of the silicon substrate away in order to leave behind the desired geometries
- Prior to 1987, these micromechanical structures were limited in motion
- During 1987-1988, a turning point was reached in micromachining -for the first time, techniques for integrated fabrication of mechanisms (i.e. rigid bodies connected by joints for transmitting, controlling, or constraining relative movement) were demonstrated
- During a series of three separate workshops on microdynamics held in 1987, the term **MEMS** was coined.
- First commercialization of MEMS occurred in the 1990s

MEMS Market Snapshot

The World of MEMS Today...

- Several billions of revenue is generated
- 30 companies generate majority of revenue
- Dominated by captive fabs
  (Analog Devices, Bosch, TI, HP, etc.)
- Only a small portion of the overall revenue is generated by independent pure MEMS foundries (ex. Micralyne)



… a leading developer and manufacturer of MEMS products…

- Founded in 1982; private company since 1998
- Continuously profitable; fast growing business operation
- 170+ staff; 50,000 sq. ft. facility (Class 10 clean room)
- Development: 25 R&D engineers, 18 Process engineers
- Manufacturing: 100+ operators; IS0 9001:2000 registration
- International base of customers (US, Europe, Japan)
- Majority of revenues come from OEM manufacturing customers

Business Model

Product Development

- Micralyne develops and integrates manufacturing processes
- Translate application needs into commercially manufacturable design

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- Class 10 clean room
- 24 yr + track record
- 25+ in R & D

Transfer To Manufacturing

- Match process to required final specifications
- Sets up statistical tracking systems for keeping processes within specifications

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- Strong Process Engineering group 18+ Engineers

OEM Manufacturing

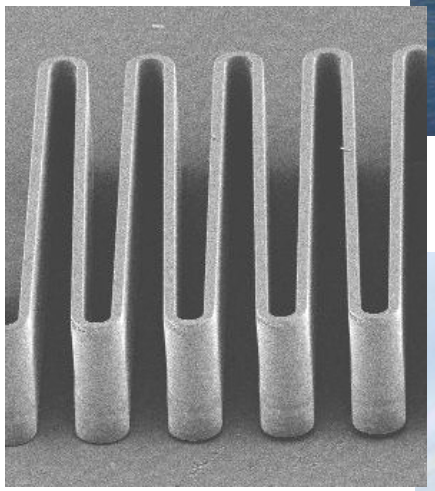
- Supply Known Good Die (“KGD”)
- Focus on ongoing quality improvements & cost reductions

- ISO-9001:2000 registration
- 100+ in Operations

Micralyne Serves...

Transportation

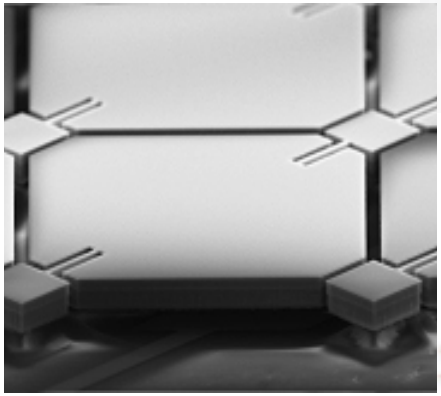
- Automotive
- Aerospace

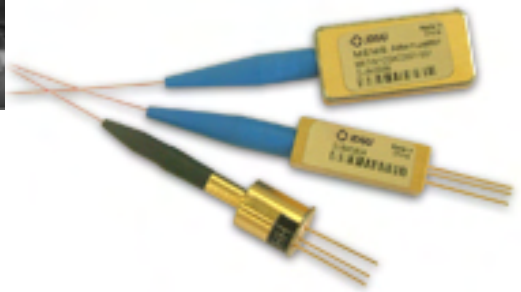


Micralyne Serves...

Communications

- Optical Telecom
- Commercial Printing
- Mobiles / PDA

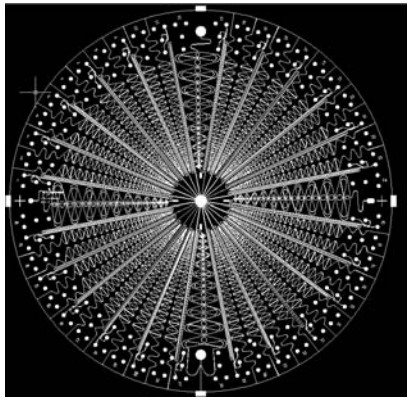


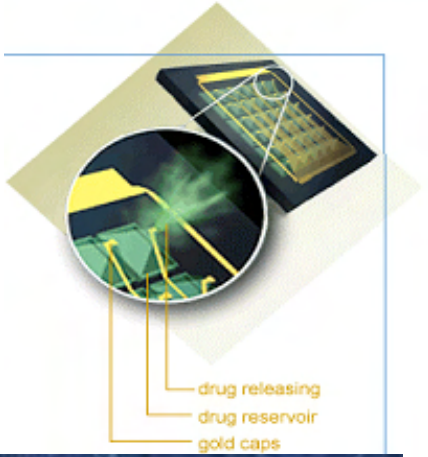


Micralyne Serves...

Life Sciences

- Drug Discovery
- Drug Delivery
- Diagnostics
- Medical Devices





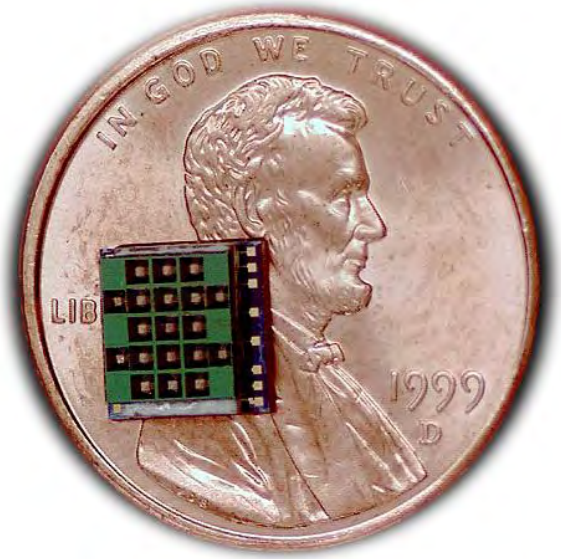
Micralyne Serves...

Energy

- Oil & Gas Sensors
- Power Devices
- Environment Sensors

MEMS Examples...

- Examples of MEMS Devices
  - Inkjet Print-Heads & Nozzles



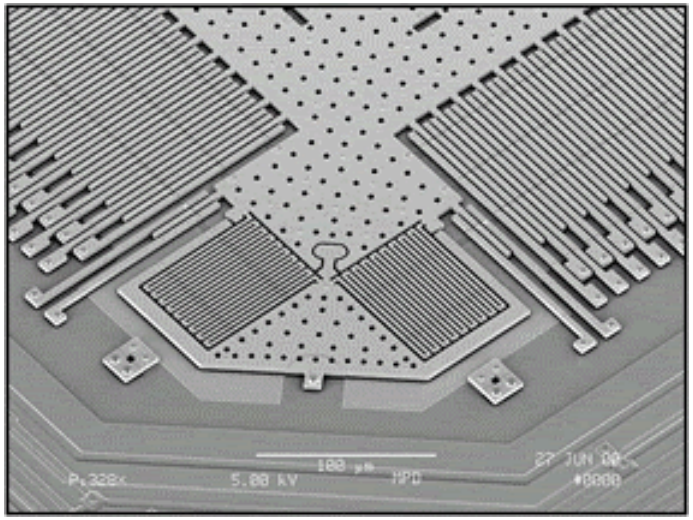
MEMS Examples...

- Examples of MEMS Devices
  - Digital Light Processing™ (DLP) Technology

Digital Micromirror Device (optical semiconductor)

MEMS Examples...

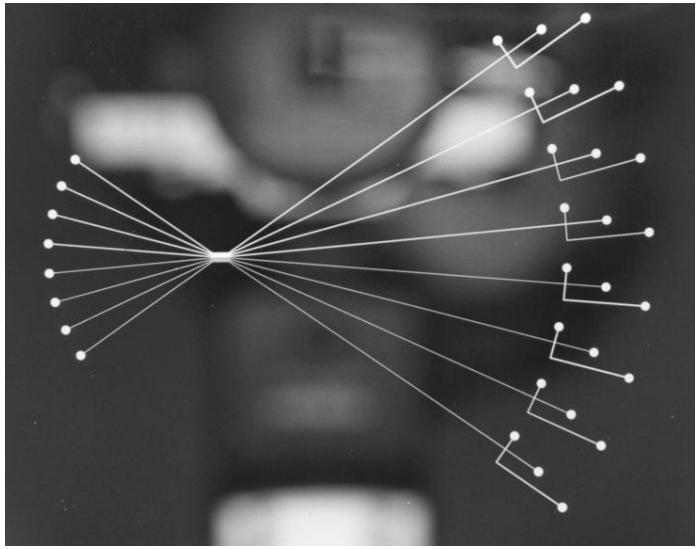
- Examples of MEMS Devices
  - Airbag Accelerometer

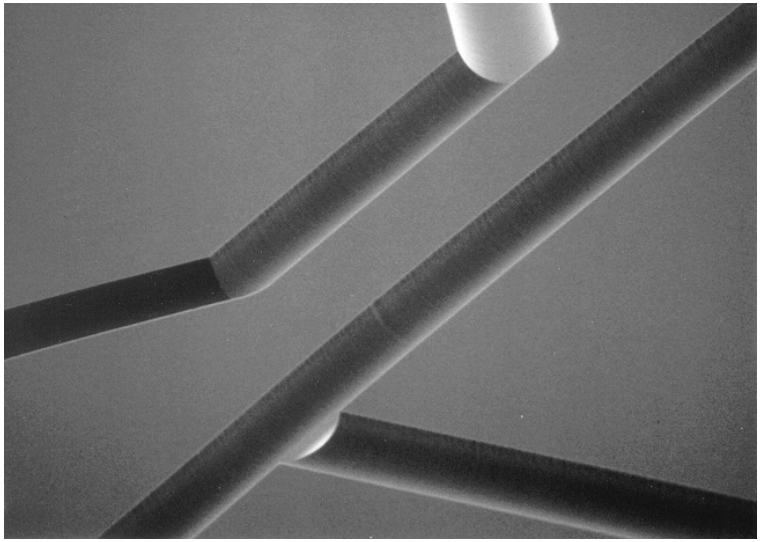


Courtesy: Analog Devices

MEMS Examples...

- Examples of MEMS Devices
  - Microfluidic Applications
    - Genetic Analysis Machines
    - Drug Discovery



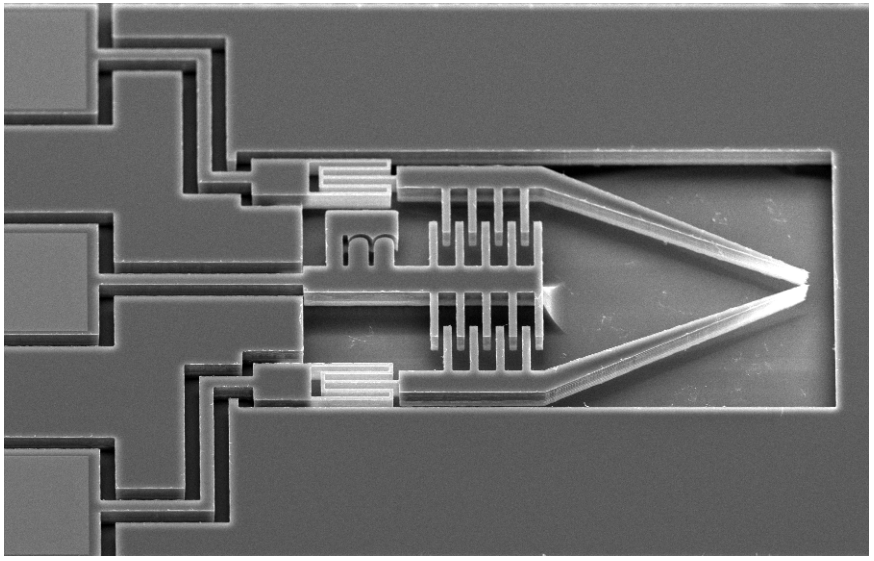


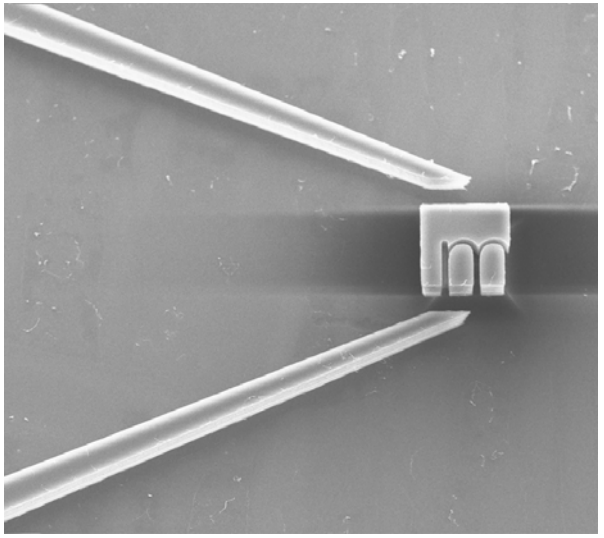
MEMS Examples...

- Examples of MEMS Devices
  - Key Component in Commercial Printers

MEMS Examples...

- Examples of MEMS Devices
  - Micro-Grippers





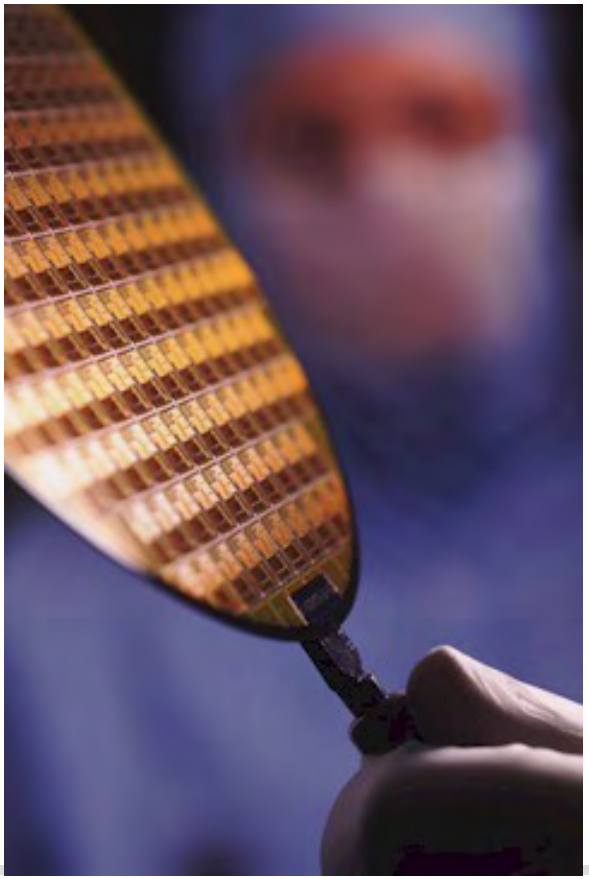
Technology...

- How Do We Create MEMS Devices?
  - Precision micromachining
  - We build up or bond structures with different materials – layer by layer
  - Then we selectively etch away different layers to make 3-D structures

An Example...

Building a MEMS Optical Switch…

Start with a base silicon wafer…



An Example...

Start with a base silicon wafer…

An Example...

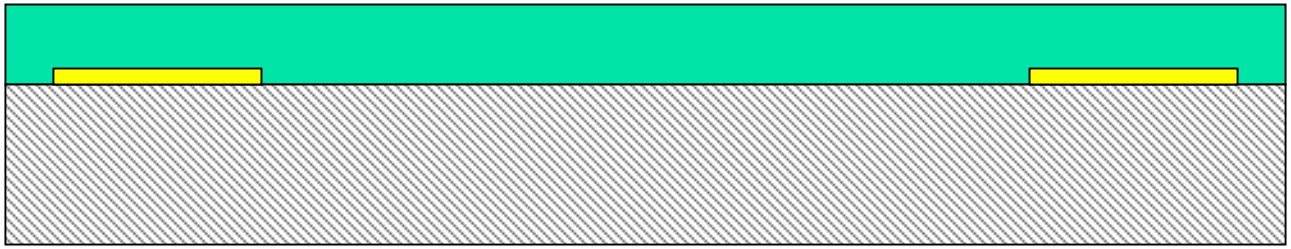
An Example...

Add pads of metal to conduct electricity…

An Example...

An Example...

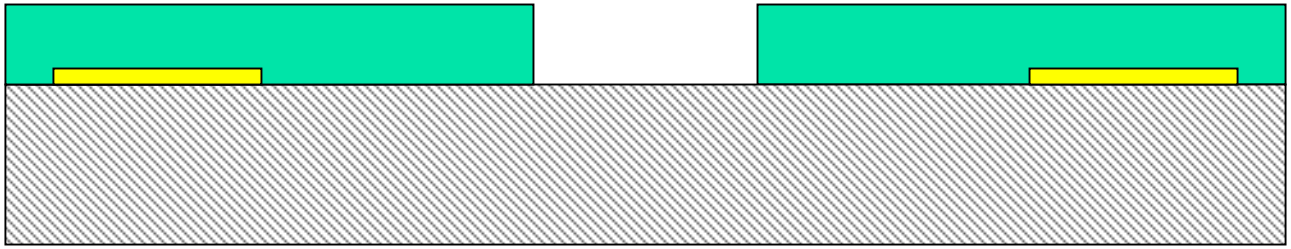
Add sacrificial layers…



An Example...

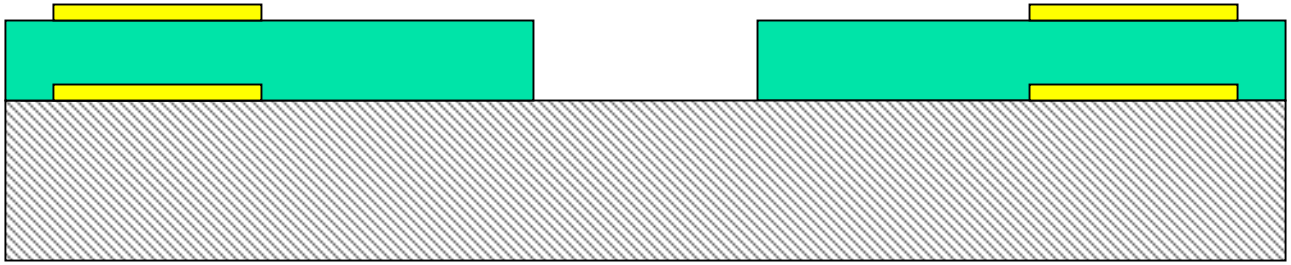
An Example...

Etch away certain areas...



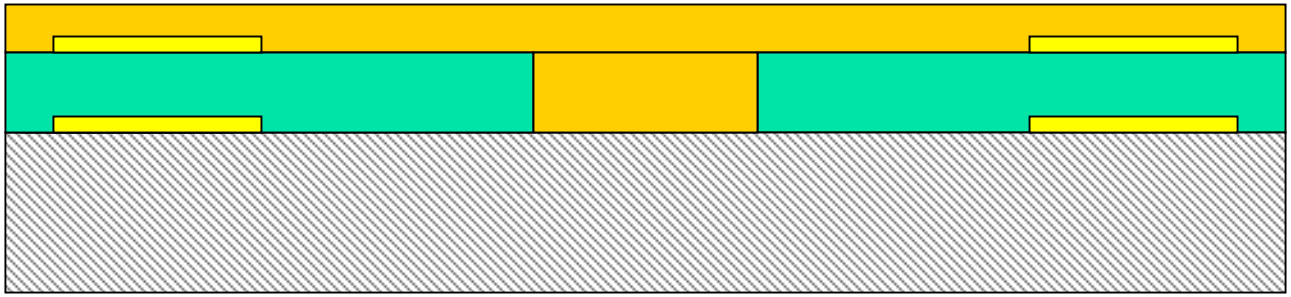
An Example...

Add more metal pads...



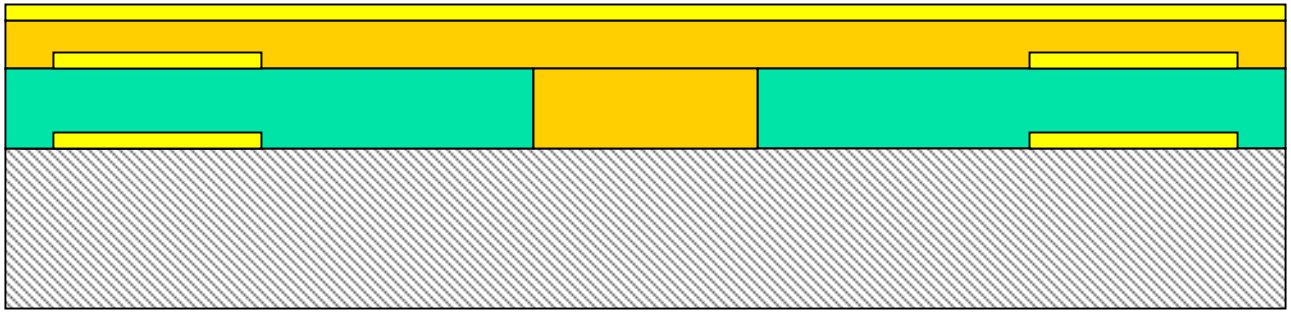
An Example...

Add structural layers...



An Example...

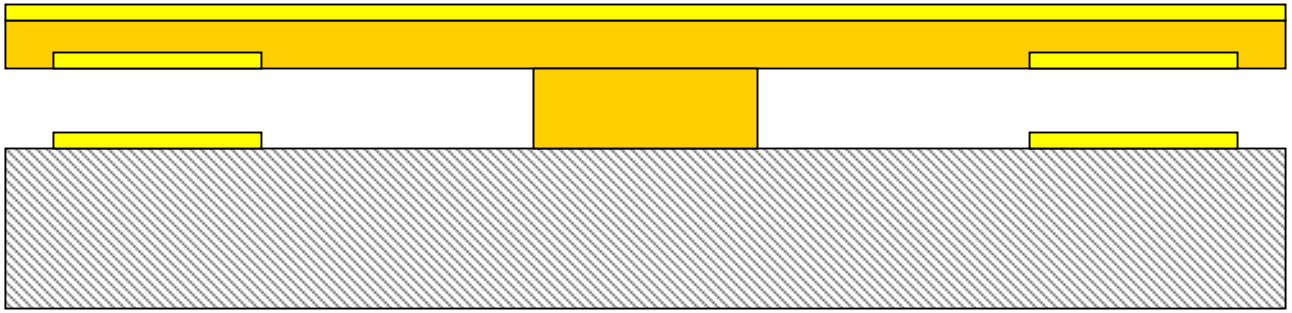
Add a highly reflective surface on top…



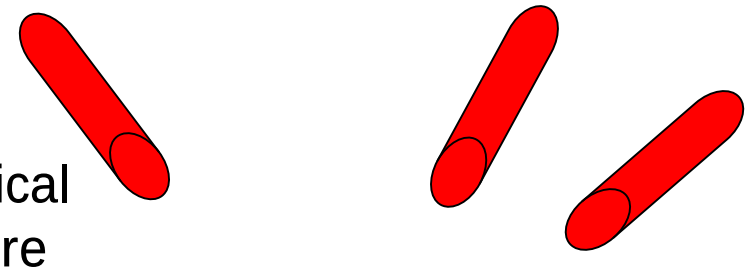
An Example...

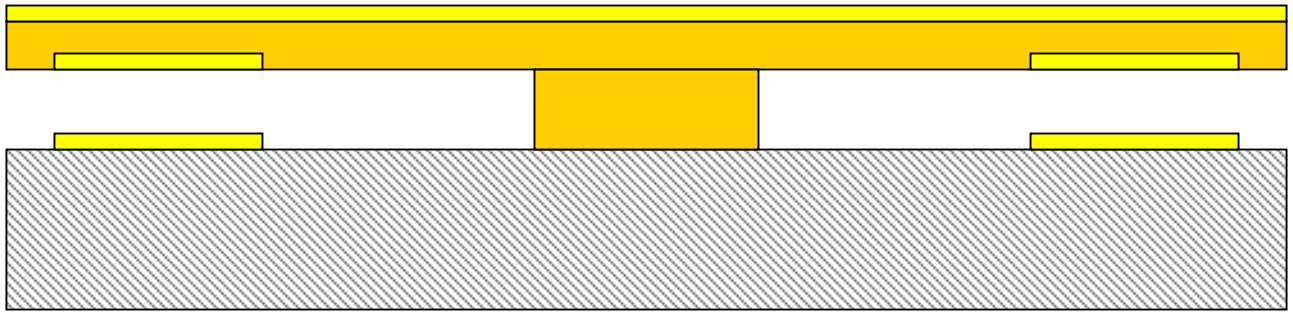
An Example...

Etch away sacrificial layers...



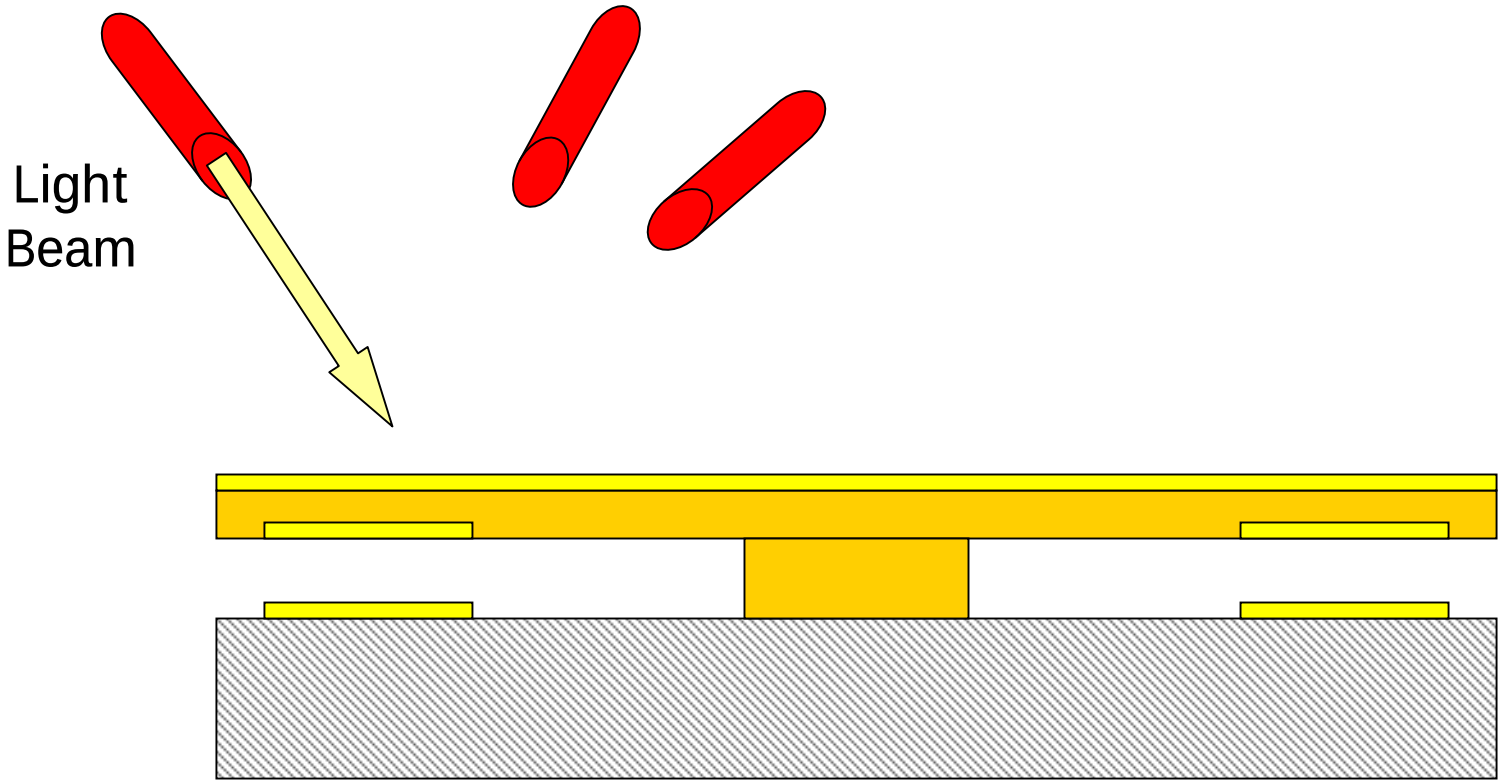
An Example...





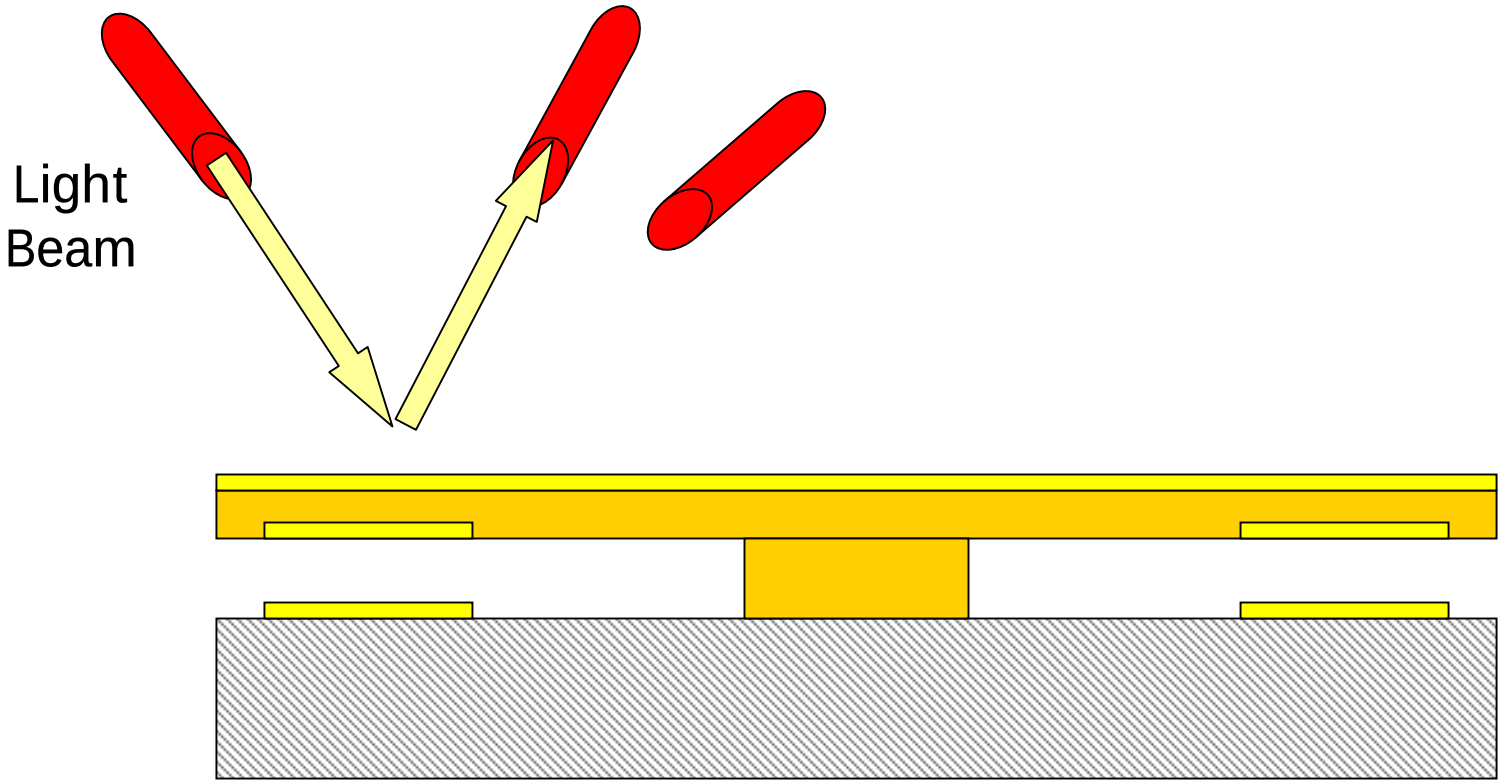
Example of optical telecom MEMS switch...

An Example...



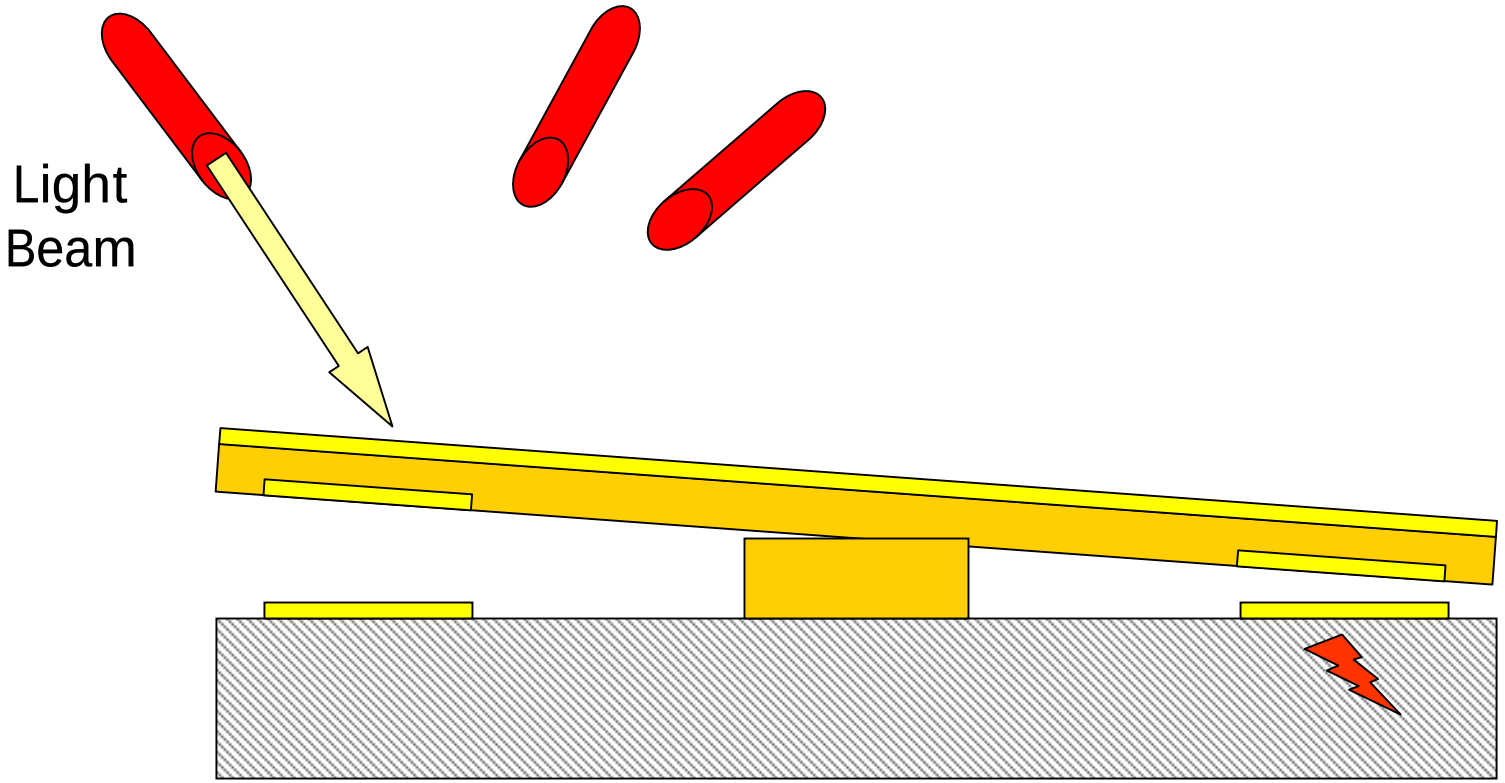
Light shines through optical fibres...

An Example...



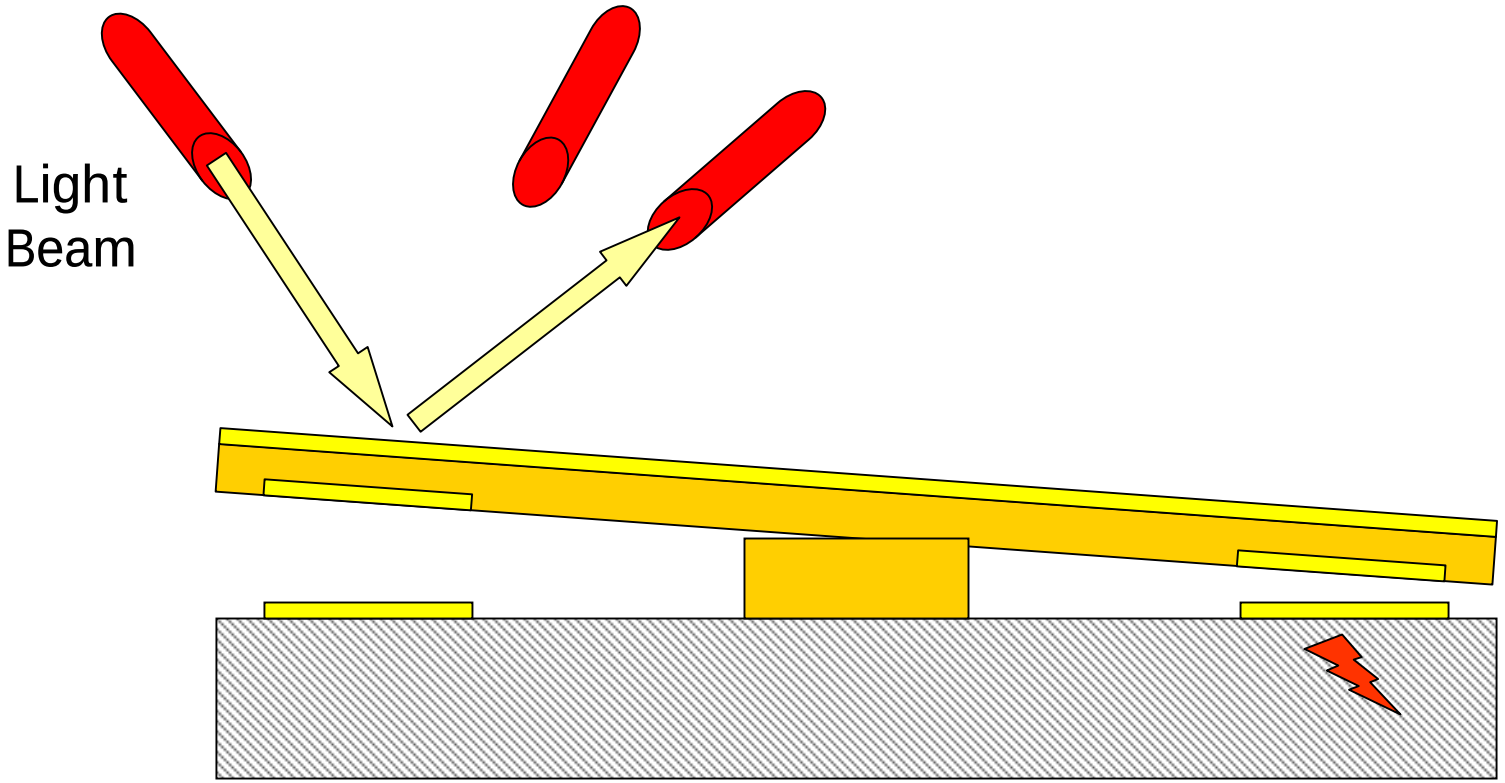
Light shines through optical fibres...

An Example...



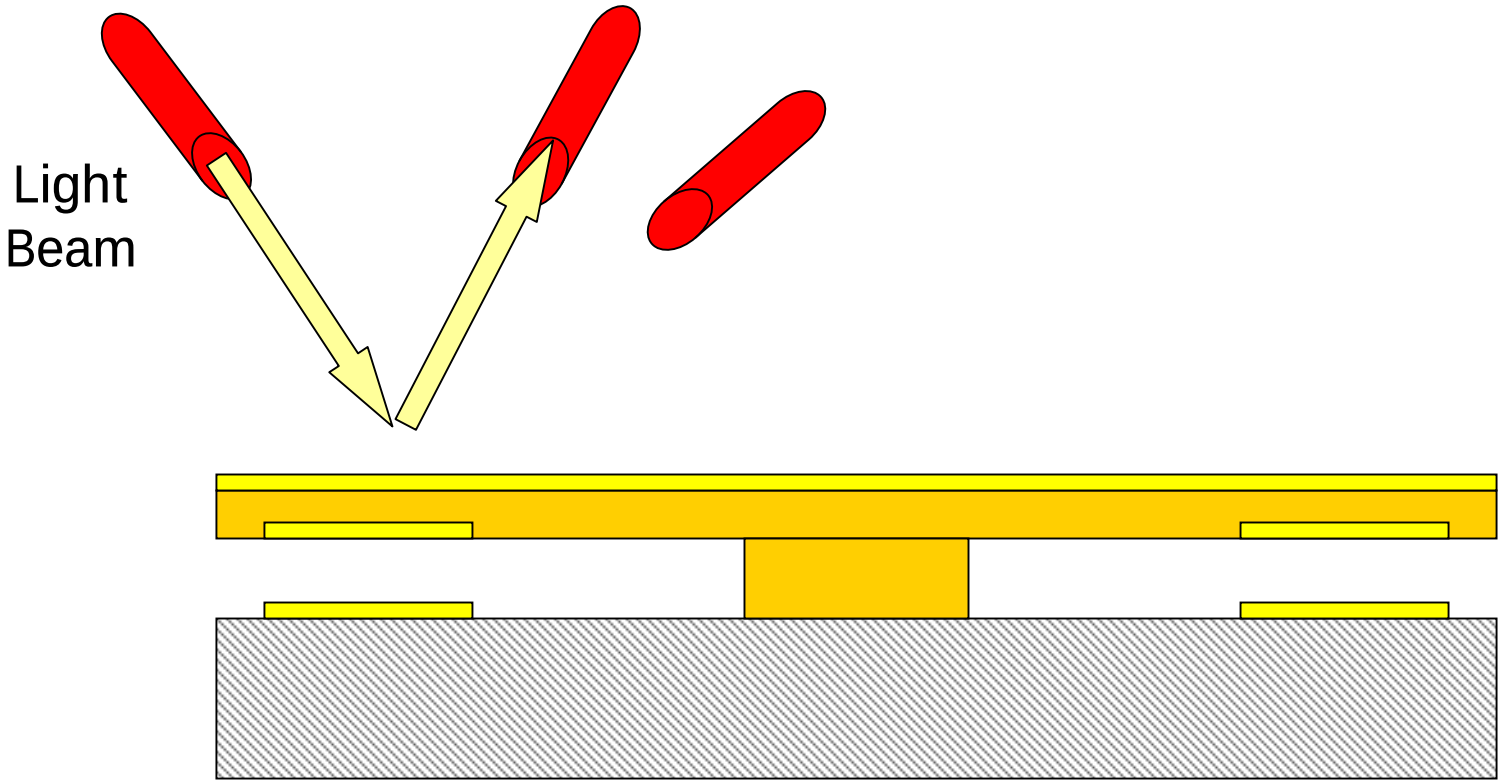
Apply an electrical force; mirror moves and light travels through a new fibre…

An Example...



Apply an electrical force; mirror moves and light travels through a new fibre…

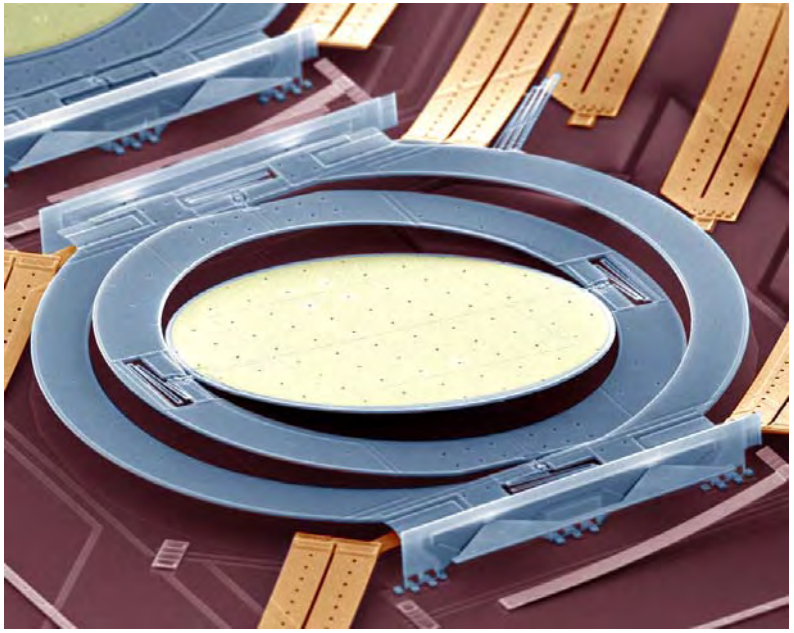
An Example...



The result:

- **Exponential increases in optical capacity – eliminates bottlenecks**
- **Dimensions: 2 mm X 2 mm**

What it looks like...



The Future

- Capturing Emerging Opportunities
  - MEMS technology is primarily still emerging
  - Fundamental value proposition of making instrumentation smaller, faster and less expensive
  - Excellent opportunities for Edmonton and Alberta

Thank You!

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