Is it possible to collaborate in a very competitive MEMS market?

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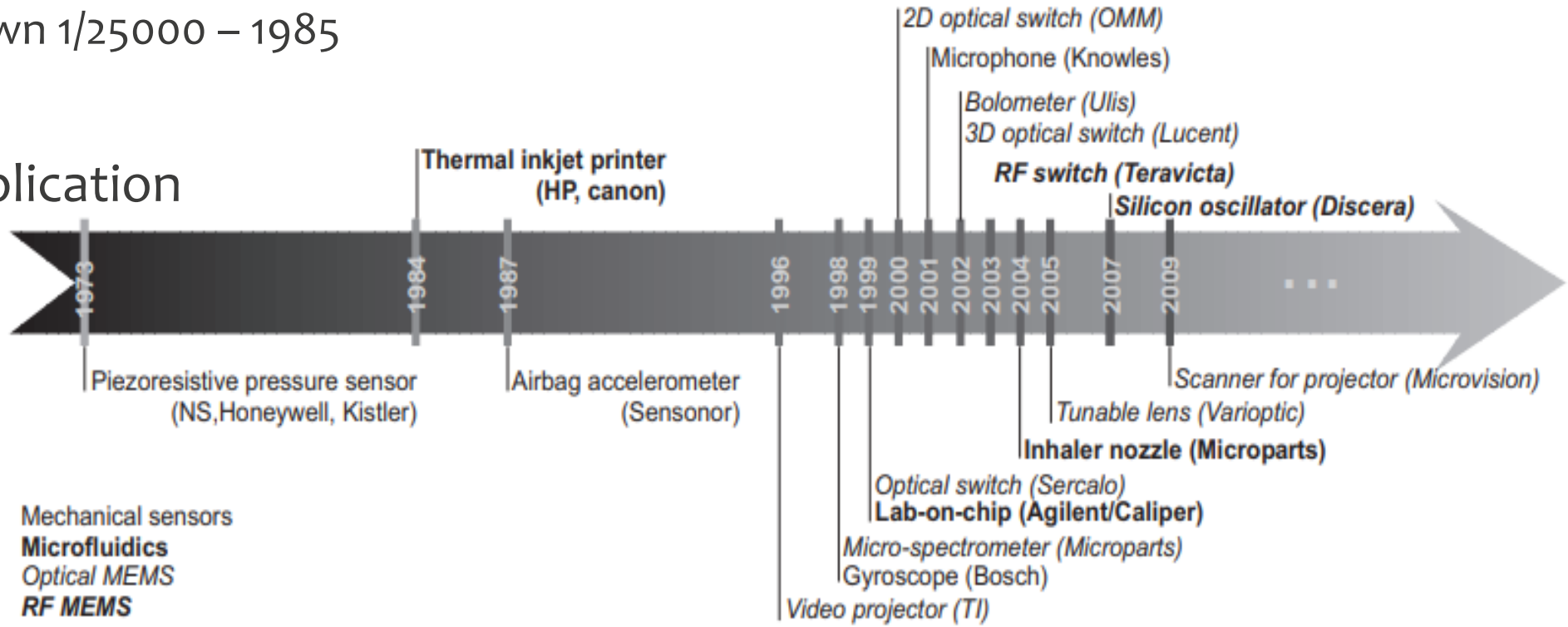
MEMS World Summit

C2MI Reinventing Innovation

INTRODUCTION

- Richard Feynman: "There's Plenty of Room at the Bottom" 1959
  - Two challenges:
    - Micro-motor – 1960
    - Scaling down 1/25000 – 1985
- Miniaturization
- Diversity of application
- Niche markets
- Competition



http://memscyclopedia.org/Document/IntroMEMS.pdf

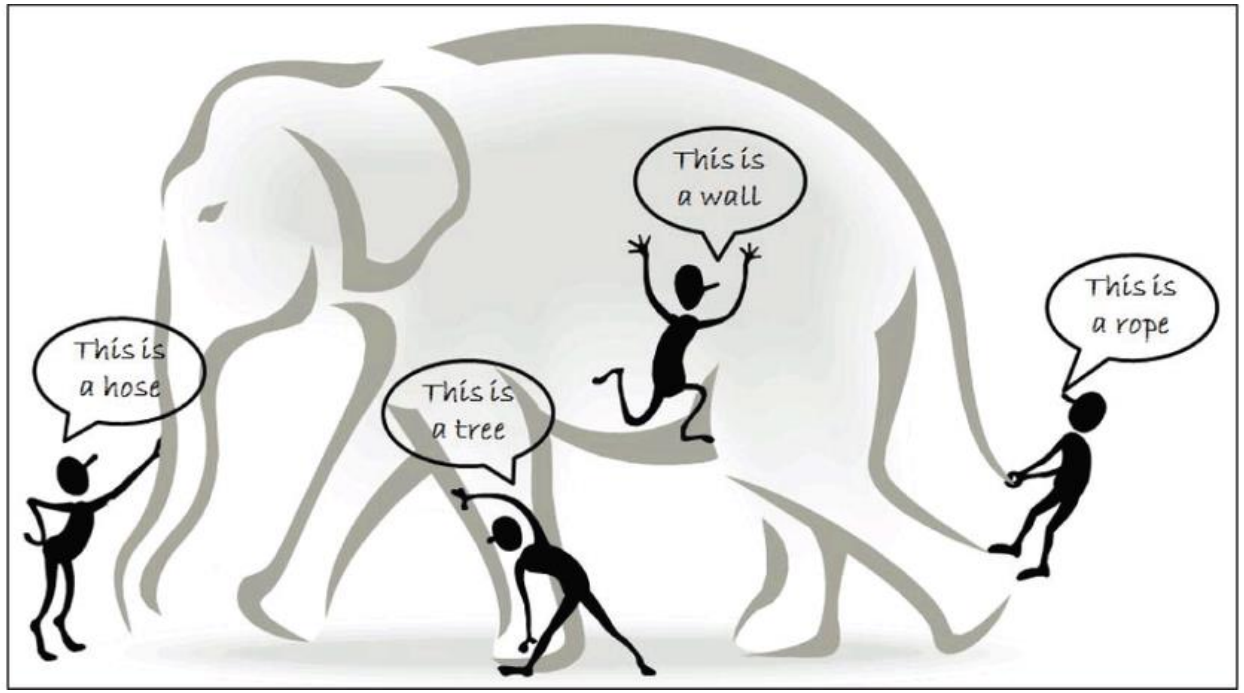
STATEMENT OF THE PROBLEM

- Many fields looking into miniaturization using MEMS
  - Automotive
  - Communication
  - Point-of-care devices/Lab-on-a chip, etc.

- Many competitors
  - Development of new MEMS-based sensors
  - Working on the same application
  - Shorten the time to market
  - Importance to be the first

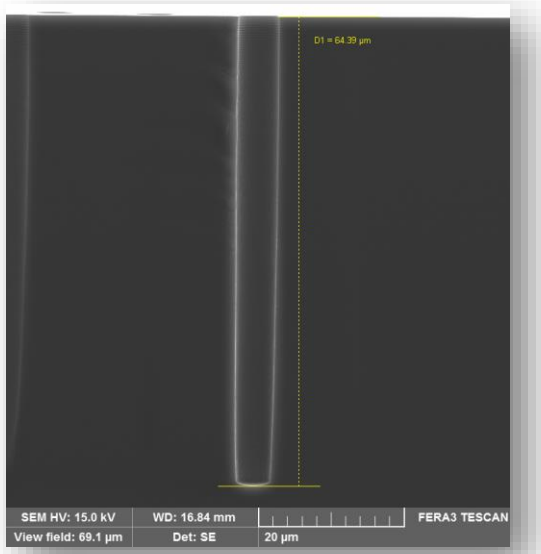
PROPOSED SOLUTION

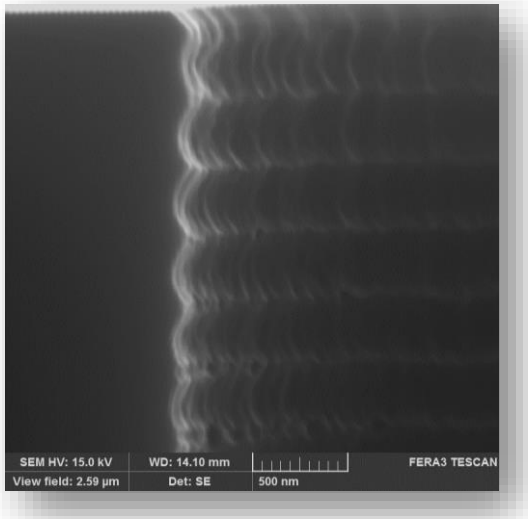
- Companies in a competitive market
- Is there any way to collaborate?
- Proposal comes from the experience:
  - MEMS could be complex
  - Creation of each device comprises numerous steps
  - Individual steps do not constitute the whole device and cannot be reverse-engineered
- One of collaboration models is the development of individual steps



EXAMPLE 1: H2 anneal development

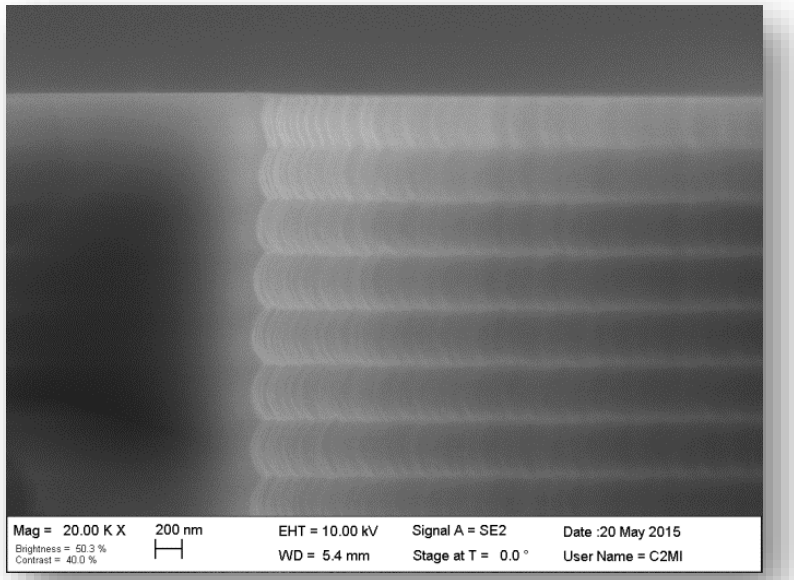
- Necessity of high aspect ratio features in MEMS
  - Created by DRIE – scalloping
- Si roughness smoothing technique in MEMS
  - Smaller scalloping and other variations of RIE
  - Thermal oxidation
  - H2 anneal
- H2 anneal smoothing uses Si migration phenomena
  - High temperature
  - Hydrogen ambient
  - Low pressure
- Single wafer equipment

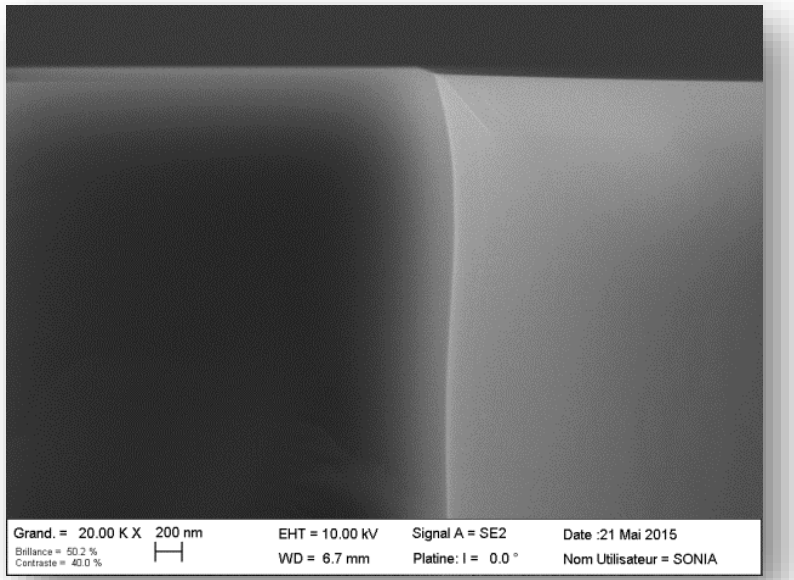




EXAMPLE 1: H2 anneal development

- Development of the H2 anneal in a vertical oxidation furnace
  - Andy Bavin (SPT)
  - Mouawad Daher (SPT)
  - Khaled-Amir Belarbi (Teledyne Dalsa)
- Sub-atmospheric, batch side-wall smoothing
- Demonstration of technology to numerous clients



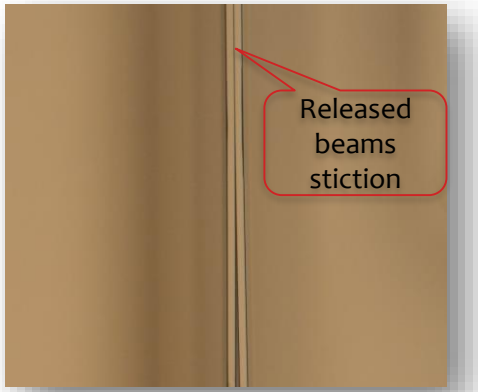


EXAMPLE 2: Optimization of the wafer drying cycle

- Marangoni-type drying
  - "Mass transfer along an interface between two fluids due to a gradient of the surface tension"
  - Two fluids with different surface tension
    - DI water
    - IPA
- Akrion Gama Wet Processor
  - Fully automated
  - Dry in/Dry out
  - LuCID Dryer, i.e. Low Consumption IPA Dryer

EXAMPLE 2: Optimization of the wafer drying cycle

- Use of existing LuCID Dryer system on Akrion Gama wet bench to develop the optimized drying and stiction prevention
  - Master of Science student, Pooya Laamerad
  - Akrion process engineer
- Developed two sets of processes dedicated to:
  - Optimal drying
  - Stiction prevention

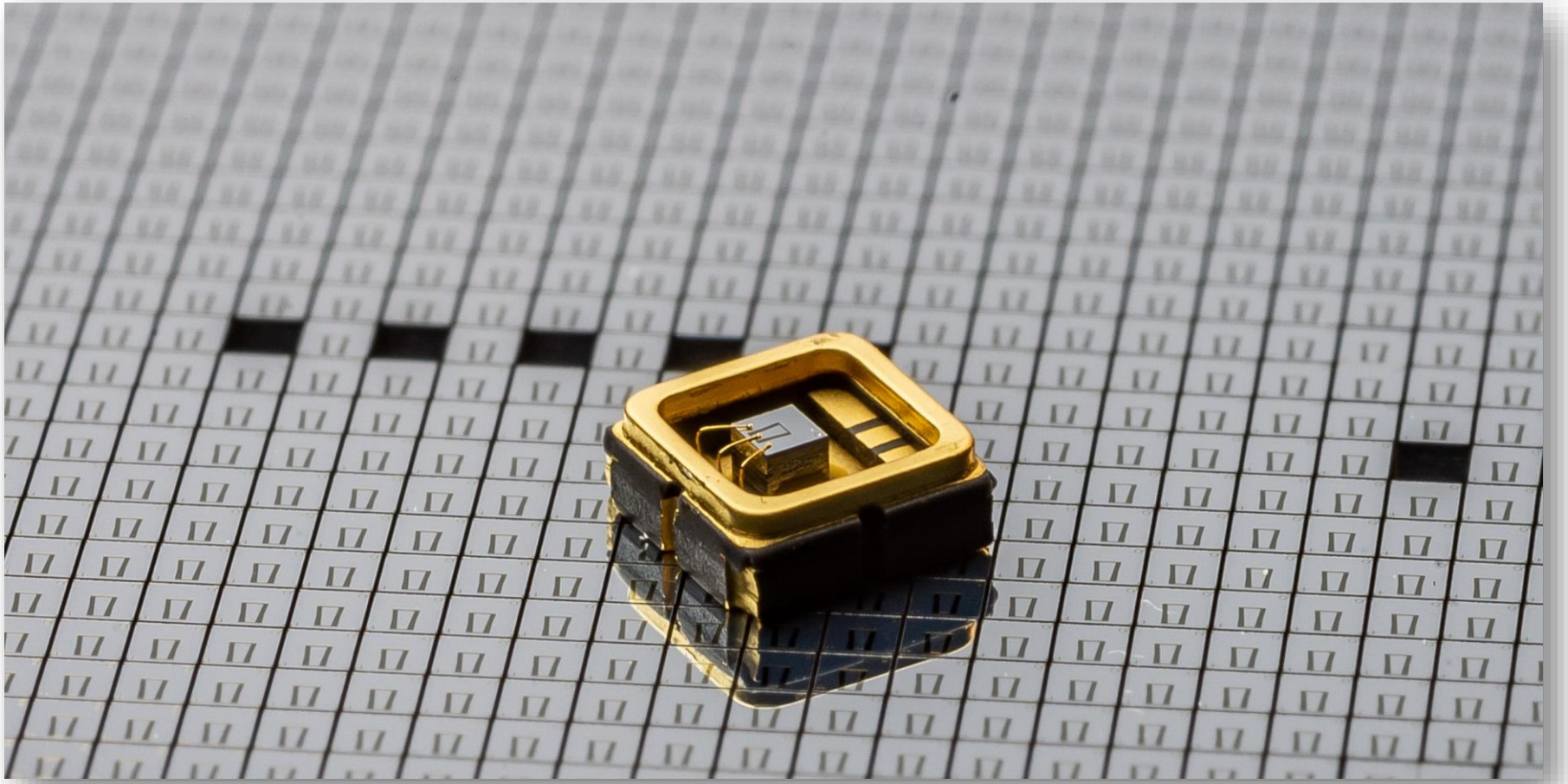


EXAMPLE 3: MEMS and the Assembly

- Development of the sensor SFS2070 for Indoor Air Quality
- The company created by a successful collaboration of three universities
  - Cambridge University
  - Universidad Politecnica de Madrid
  - Warwick University
- Device fabrication in MEMS Fab
- Introduction to the advance packaging in the same facility
- Close collaboration between the two departments
  - Device fabrication
  - Dies singulation
  - Dies placement and wire bond
  - Ceramic substrates singulation

EXAMPLE 3: MEMS and the Assembly

- SFS2070 for Indoor Air Quality



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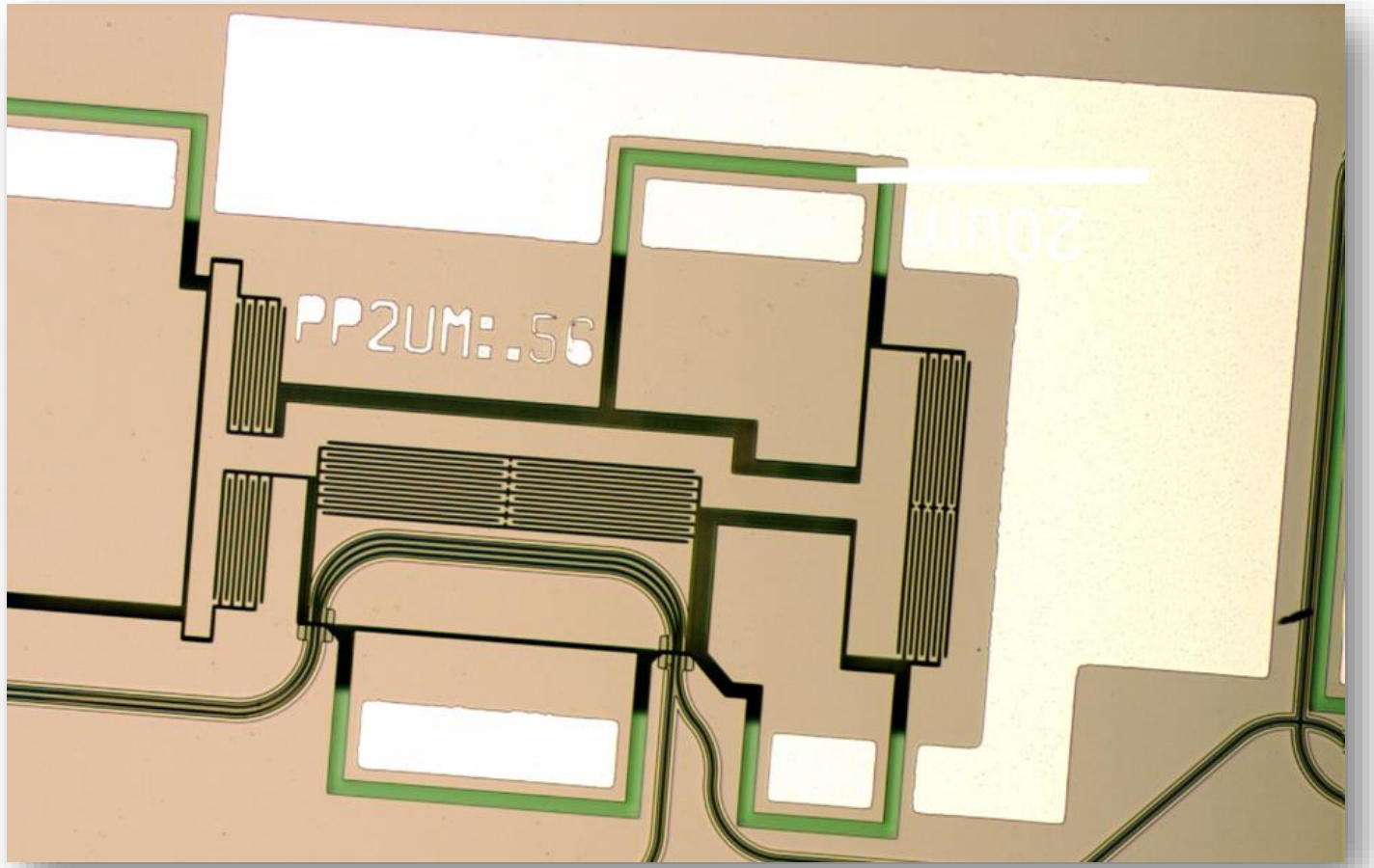
EXAMPLE 4: Optical Switch

- Optical switch development – base product
- Have a right idea
- Find the right people to execute this idea
- Willingness to share and the ability to let go of some of the control
  - Know how to put the necessary protection in place, e.g. patent
  - Support applied research
  - Allow the possibility to publish
  - Keep projects reasonable in size – with the clear end
- Knowledge of the MEMS world
  - Find more than a single foundry

EXAMPLE 4: Optical Switch

- Creation of different components to be integrated on the same platform



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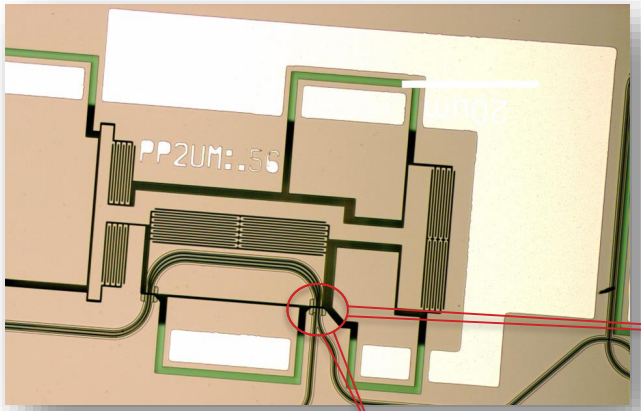
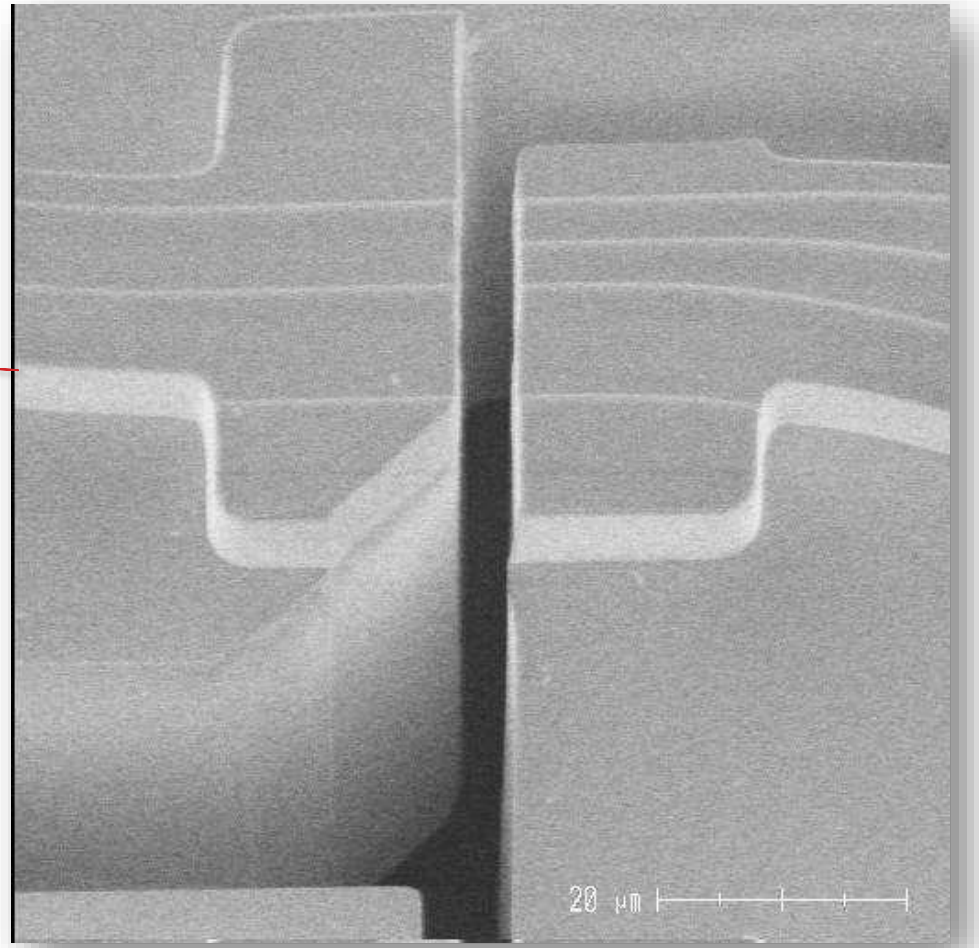
EXAMPLE 4: Optical Switch





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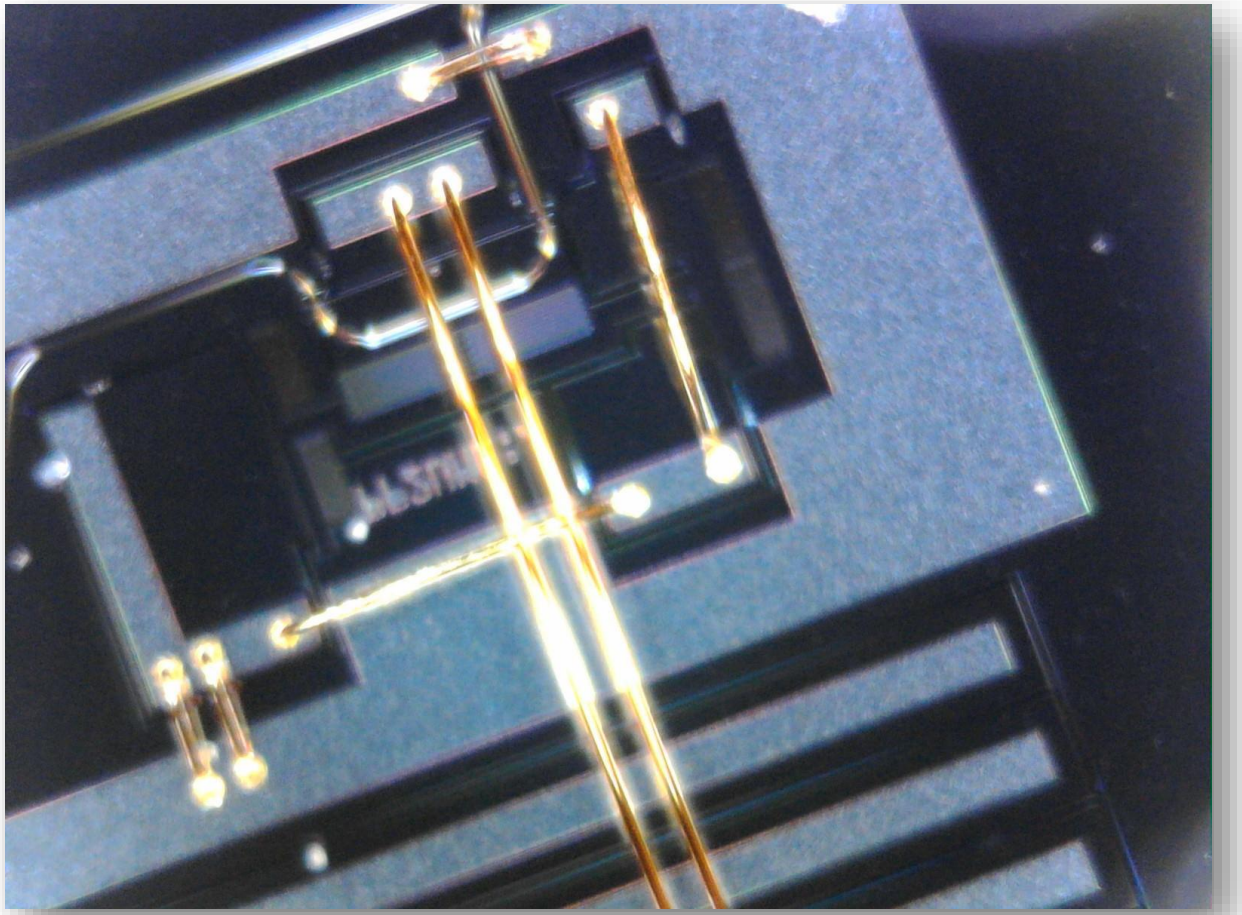
EXAMPLE 4: Optical Switch

- Use of stealth dicing for die singulation, opto-electronic assembly, and advanced packaging



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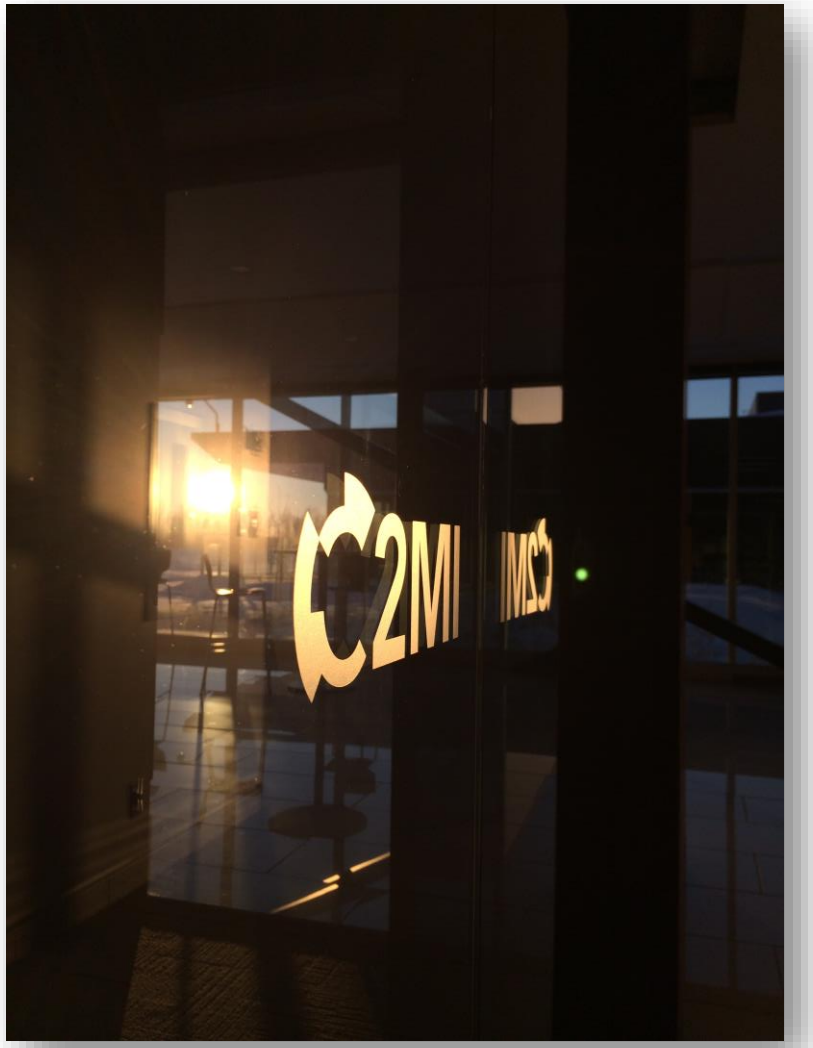
C2MI – MiQro Innovation Collaborative Centre



C2MI organization

- Founded in 2010
- Infrastructure owned by University of Sherbrooke
- Non-for-profit entity
- Qualified CECR

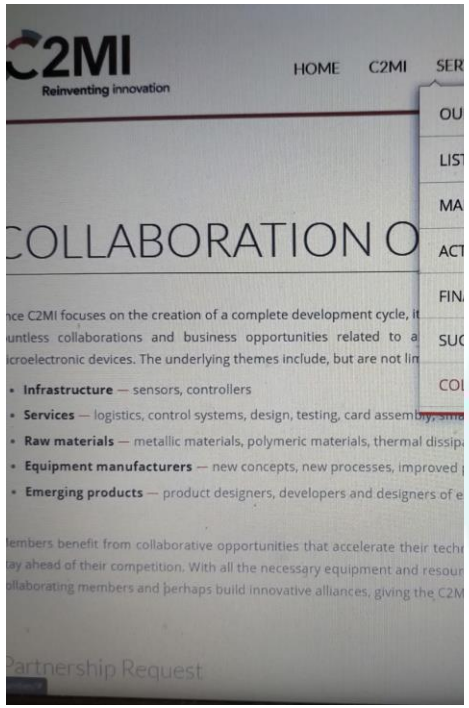
CENTRES OF EXCELLENCE FOR COMMERCIALIZATION AND RESEARCH PROGRAM

Initial investment of 221M$

- 83M$ from Canada
- 95M$ from Québec
- 43M$ from more than 70 equipment vendors & partners
- More than 23M$ added in equipment since 2011

- **200 mm MEMS foundry**
- **Assembly**
- **Card-attach**
- **Printed electronics**
- **Reliability Laboratory**
- **Analysis Laboratory**

C2MI A powerful model



www.c2mi.ca

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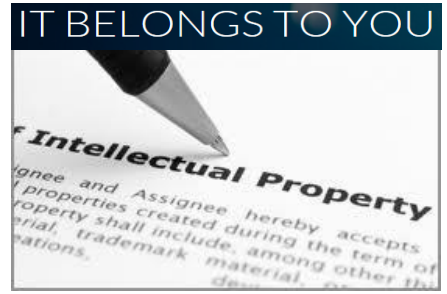

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