

# AMFitzgerald Company Overview

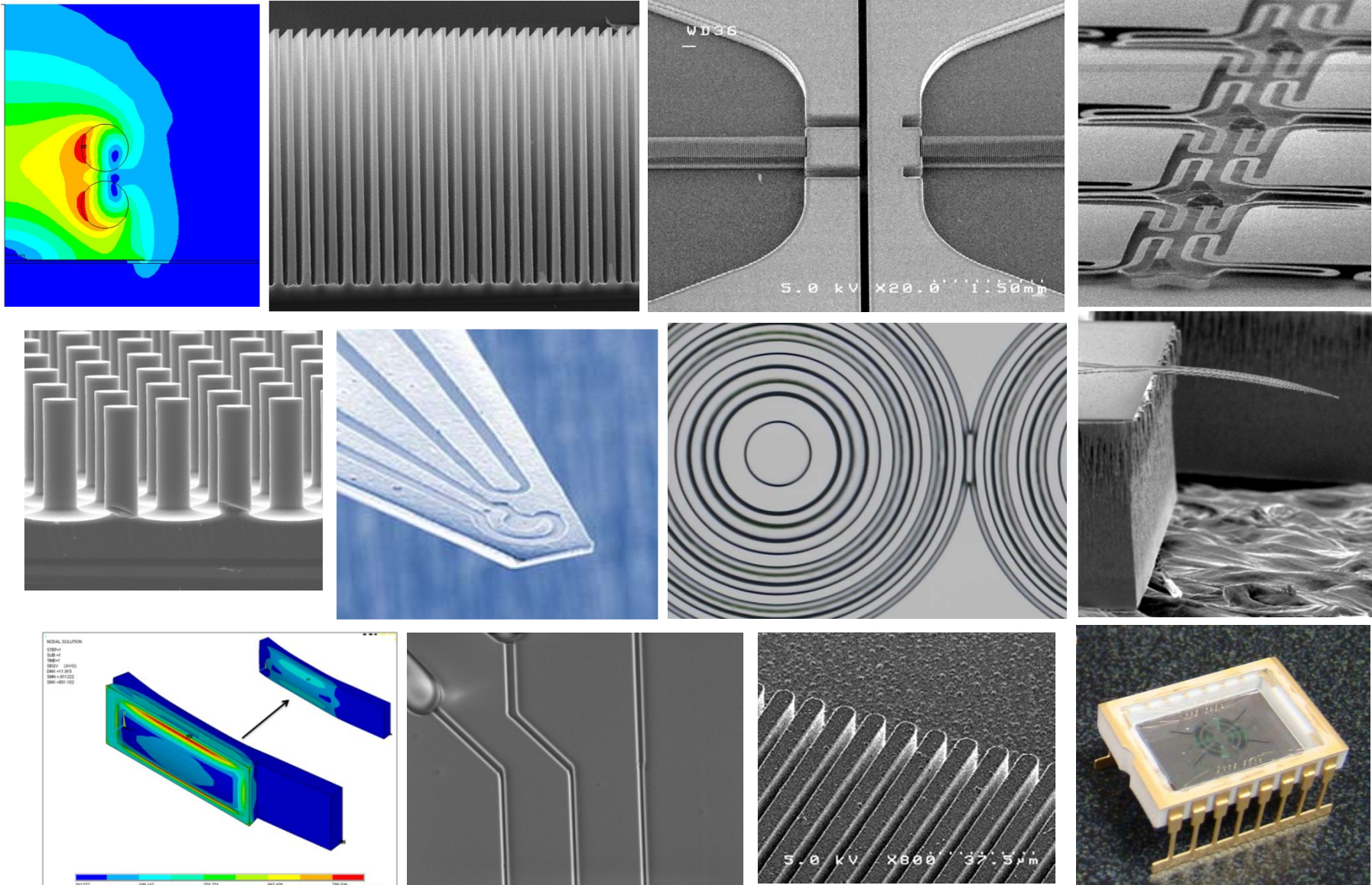
May 2013



AMFITZGERALD  
& ASSOCIATES



# Mission: Your Partner in MEMS Product Development





## Company background

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- **Founded 2003 by Alissa M. Fitzgerald, self-funded**
- **Burlingame, CA: near SFO and Silicon Valley**
- **Goal: become the premier MEMS product development firm**
- **Consistent growth**
  - Over 110 clients served to date
- **Active member of the MEMS Industry Group**



Headquarters in Burlingame, CA

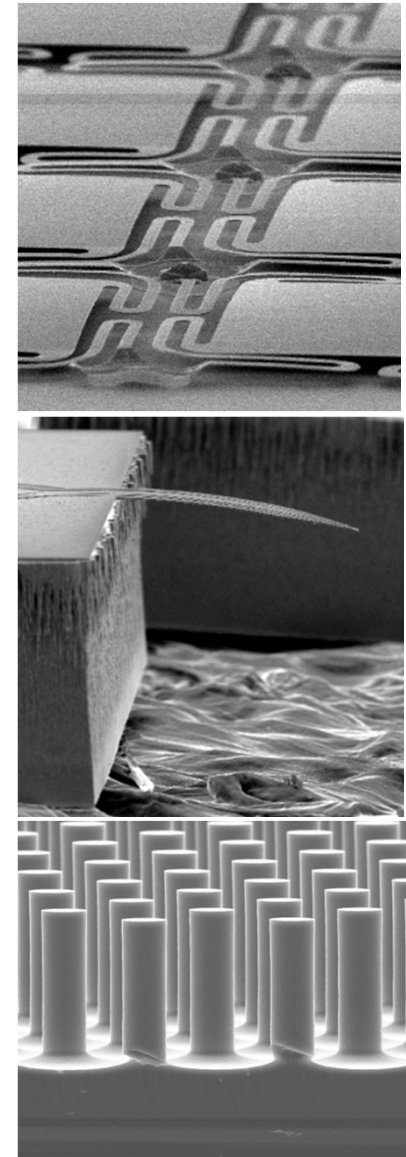


Fab operations at UC Berkeley  
Marvell Nanolab

## Our value

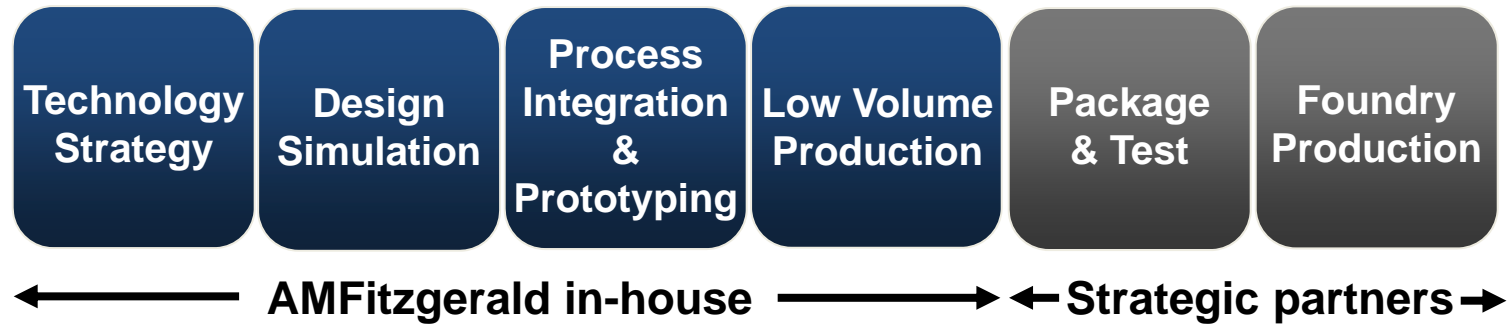
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- **First time developing MEMS?**
  - We can provide the complete solution
- **Improving your MEMS product?**
  - Let us optimize your design
- **Investing in MEMS?**
  - Valuable insight from expert practitioners
- **Our competitive advantage**
  - A complete MEMS solution
  - Expert design and process engineers



## A complete solution from concept to production

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- **Make vs. buy decisions; technology roadmaps**
- **R&D management, multi-disciplinary engineering team**
- **Design and process integration for volume production**
- **In-house prototype fabrication (150 mm wafers) by our engineers, not operators**
- **Smooth transition to production partners**

# Solutions beyond R&D

*A menu of production options for different customer needs*



Process flexibility

Speed to market

## A new era in MEMS development

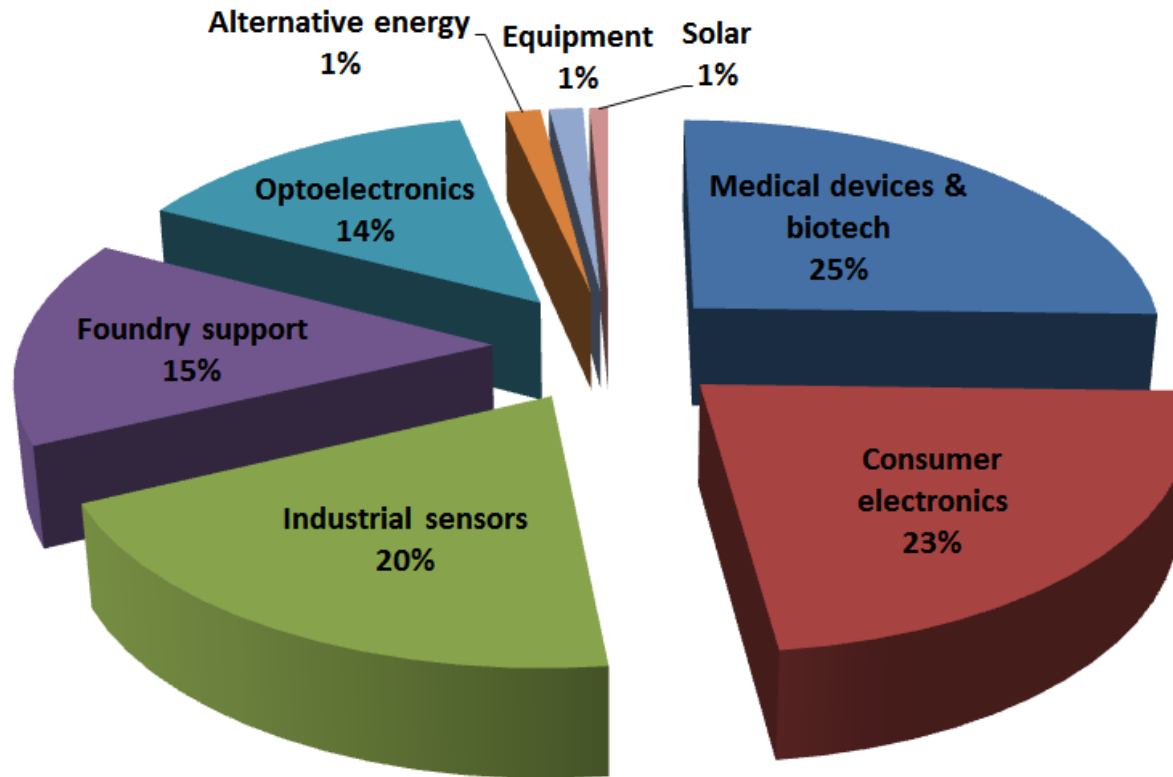
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- **MEMS solutions for OEMs and system integrators**
  - ISO-certified foundries
  - Cost-effective multi project wafer runs
- **Customer supplies sensor spec, AMFitzgerald delivers customized chips run on established foundry process**
- **First run: pressure sensors at Silex Microsystems**
- **More sensors and more foundries in the future...**

# Our diverse customer base

**AMFitzgerald customers by market: 2012**



Types of MEMS developed in 2012:

**Optical switch**

**Microfluidics**

**Microphone**

**Timing**

**Microtexture**

**Inkjet**

**Radiation**

**Motion**

**Pressure**

**Micro-mirror**

**Cantilever**

**IR imager**

**Fuel cell**

**Display**

**Chemical**



# MEMS type core competencies

- **Sensor types**
  - Motion, pressure, acoustic, infrared, magnetic, radiation, resonators, chemical
- **Transduction principles**
  - Piezoresistive, piezoelectric, electrostatic, capacitive
- **Actuators**
  - Electrostatic, piezoelectric
- **Microfluidics**
- **Micromolds and surface texturing**

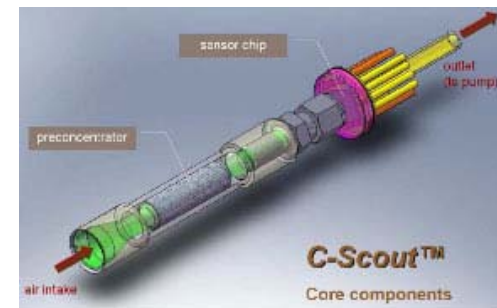
## AMFitzgerald Client Products



Cantimer OSMO Dehydration Sensor



Fluxion Biosciences BioFlux product

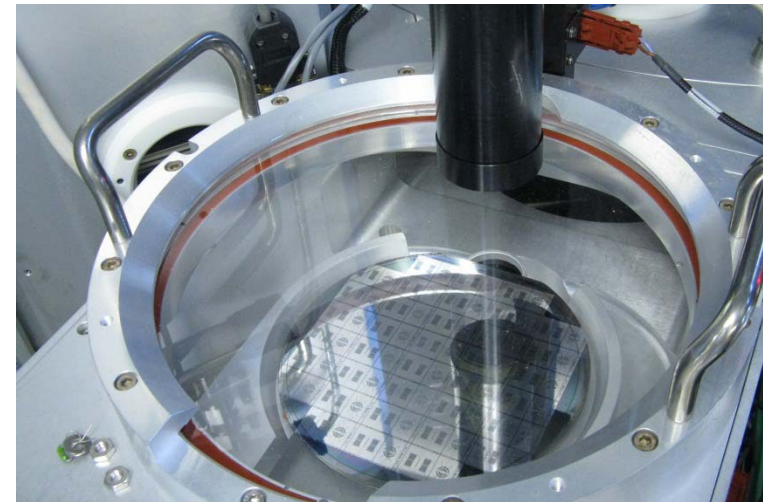


NNTS C-Scout product

# MEMS process core competencies

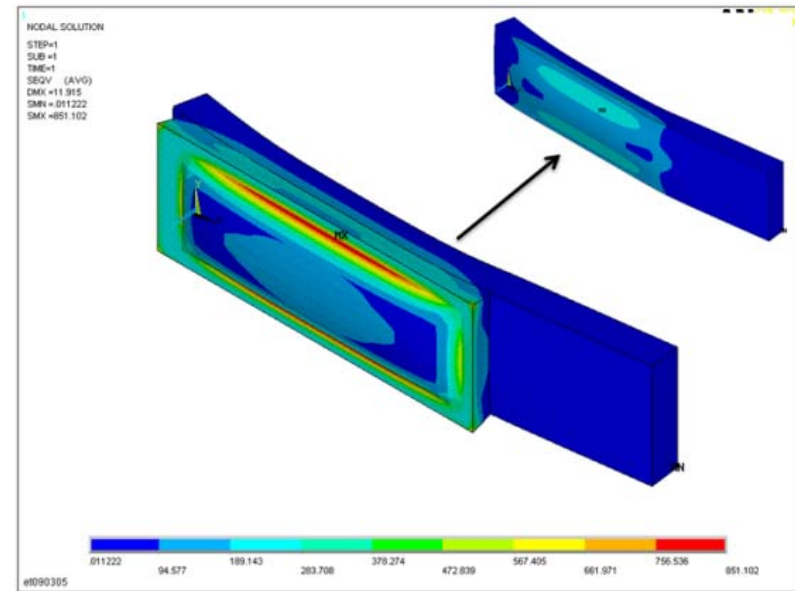
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- All MEMS process techniques
- Process specialties:
  - Thick lithography
  - High aspect ratio silicon etch
  - Sacrificial release by vapor HF or XeF<sub>2</sub>
  - Aluminum nitride and other new materials
  - Silex Sil-Via TSV
  - Laser and abrasive drilling
  - Stealth dicing
- Managing risk and uncertainty of MEMS R&D

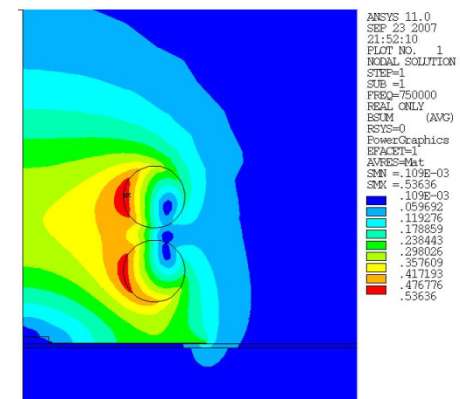


# MEMS design core competencies

- ANSYS Multiphysics
- Tanner EDA L-Edit
- SoftMEMS
- Matlab
- Proprietary fracture prediction
- Intelligent use of simulation to minimize risk and reduce fab cycles
  - Management of uncertainty in MEMS material properties



Package-induced stresses

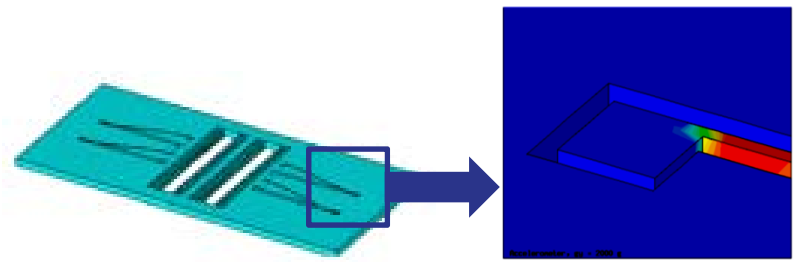


Magnetic field of inductor coils

## Case studies: Design and process integration

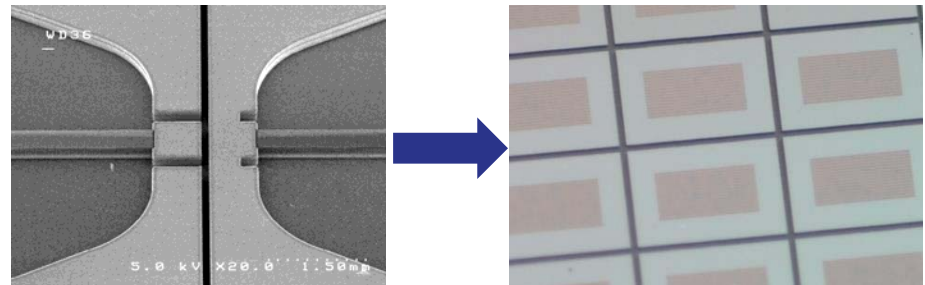
- **Accelerometer:**

- Design to specification
- Fabrication on the InvenSense NF Shuttle



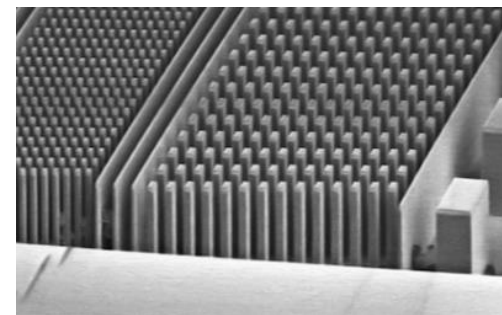
- **Microfluidic pump:**

- Redesign to lower cost of fabrication
- Prototype, then foundry transfer



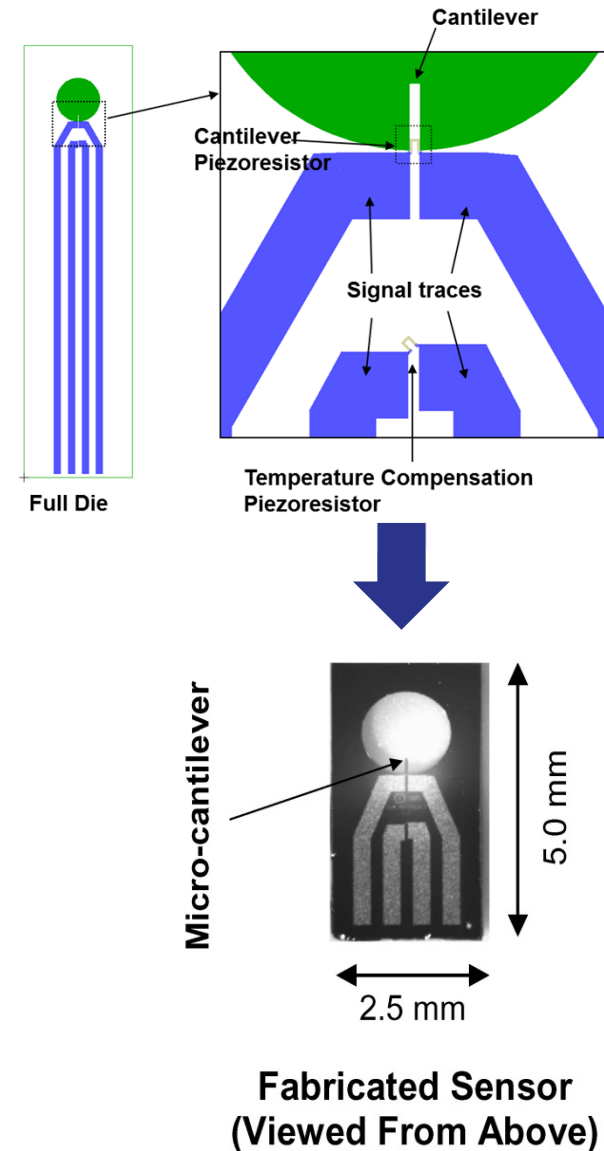
- **Process improvement:**

- Improved DRIE aspect ratio from 20:1 to 46:1 on existing toolset



# Case study: From concept to manufacturing

- **Cantimer dehydration sensor**
- **Development**
  - First prototypes functional (7 layer process)
  - Piezoresistor value matched simulation
- **Foundry Transfer**
  - Bidding and diligence process with five foundries
  - Die shrink
  - Transfer of AMFitzgerald prototype enabled > 90% yield on the first run





## Business process

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- Initial meeting: fit and scope of work
- Detailed project plan and cost proposal provided
- Project performed in discrete Phases to minimize risk
  - Phase 1: Design exploration
  - Phase 2: Prototype fabrication 1
  - Phase 3: Test and design iteration
  - Phase 4: Prototype fabrication 2
  - Etc.
- Collaborative interactions
- *Client owns all work product and intellectual property*
  - Including masks and runsheets, which will be transferred to foundries

## The secrets to MEMS development success

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- **Have adequate funds and timeline for multiple prototype iterations**
- **Robust designs do not push process tolerances**
- **Bring only mature prototypes to foundry**

# Public client list (partial)

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## Startups and Small-Medium Businesses:

Advanced Diamond Technologies  
Bay Materials LLC  
CPAC  
Cantimer, Inc.  
Edge Embossing LLC  
Endotronix  
Fluxion Biosciences  
Hepregen  
Microfabrica  
Micralyne  
NovaSpectra  
PolyOptic Technologies  
SemQuest  
Silicon Light Machines  
Silicon Microstructures  
Tactus Technologies  
Wave 80 Biosciences  
Yole Développement

## Public Companies:

Agilent Technologies  
Applied Materials  
Caliper LifeSciences  
Cypress Semiconductor  
Maxim Integrated  
Measurement Specialties  
Micrel  
Mirion  
Panasonic ACOM-TC  
Sorin  
Symmetricom  
Ricoh Innovations

## Research Institutions:

Alfred E. Mann Foundation  
DARPA  
MIT  
Stanford University  
Stowers Institute  
UCSF, Ophthalmology  
Weill Medical College of Cornell Univ.

## Company contact information

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700 Airport Blvd. Suite 210  
Burlingame, CA 94010, USA  
Phone: +1 (650) 347 MEMS  
Fax: +1 (650) 347 6366  
General Inquiries: [info@amfitzgerald.com](mailto:info@amfitzgerald.com)



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