



# CiETA

Centro de Investigación en Ciencia y Tecnología Aplicada

Transforming research and education in Mexico with advanced technology





**CiATA**  
Centro de Investigación  
en Ciencia y Tecnología Aplicada



**IEEE**  
MEMS 2011  
Cancun Mexico  
January 23-27, 2011



## REINFORCEMENT OF MEMS R&D IN MEXICO

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<sup>5</sup>Universidad Veracruzana, MX, <sup>6</sup>Centro de Física Aplicada y Tecnología Avanzada (UNAM), MX.

Six leading Mexican research and academic institutions have initiated a national collaborative program to establish a well-structured basis for MEMS research in Mexico, utilizing common design and analysis software-platforms, and sharing the available processing infrastructure.

The program is based on a little exercised paradigm within Mexican researchers/educators: sharing infrastructure and resources dedicated for research and development among Mexican institutions, so as to strengthen activities targeted towards MEMS fabrication and testing.

The project is funded by the National Council of Science and Technology (CONACYT) in Mexico, and the main objectives are as follows:

- Training of personnel (researchers and students) on MEMS design using Sandia Labs' Advanced MEMS Design Tools.
- Establishment of a MEMS research network focused on design, analysis and fabrication of MEMS structures in Mexico.
- Organization of a MEMS Design Competition to promote active participation of students in MEMS-technology issues; it is expected to be held each year.
- To identify and promote collaboration between industry and academia.
- To promote collaboration among Mexican and Sandia National Laboratories' researchers.



**Sandia  
National  
Laboratories**

### 5-year program:

*Integration of MEMS Technology in Mexico*

- Acquisition of Design Infrastructure (SUMMIT-V) for several Universities/ Research Centers in Mexico
- Training on SUMMIT-V
- Development of curricula in MEMS
- Formal MEMS-Education in UG & G programs
- Establishment of a Mexican MEMS-Design Competition (Mexican University Alliance - MUA)
- Fabrication of first batch of modules at Sandia
- Acquisition of Complementary Infrastructure for the Testing of MEMS Modules

- 2<sup>nd</sup> MUA's Competition & Fabrication of modules
- Identification of (AI) Academy-Industry teams
- Initiation of AI-projects to be addressed with SUMMIT-Sandia's Technology
- Fabrication of MUA-modules. Research /AI
- Identification Focus Areas for MEMS research -RFMEMS, BioMEMS, Sensors
- Perform complete testing cycles of MEMS
- Packaging of MEMS devices - assessments

- 3<sup>rd</sup> and 4<sup>th</sup> MUA's Competition & Fabrication of modules
- Expansion of AI-teams
- Expansion of AI-projects to be addressed with SUMMIT-Sandia's Technology
- Fabrication of MUA-modules. Research- and AI-projects
- Acquisition of further infrastructure for MEMS process development
- Development/Identification of alternative processes to SUMMIT-V
- MEMS Workshops/Colloquia
- Formulation of extended AERI-MEMS projects
- Application-driven projects
- Development/Identification of MEMS Embedded Systems Integration
- MEMS-CMOS Design Centers / MEMS Network
- Commercial MEMS Manufacturing in Mexico
- Expanding collaboration with Sandia - LIGA Nanotechnology .... Joint Research/Projects

2010

2011

2012

2013-2014

## National Projects (FORDECYT Conacyt)

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- Project title “Establecimiento de un Programa Nacional para el Diseño y Fabricación de Prototipos MEMS (Micro-Electro-Mechanical Systems)”
- Total funded \$22M pesos, ~€1.3M
- Collaboration with institutions:
  - Centro Nacional de Metrología (CENAM, Querétaro QRO),
  - Universidad Autónoma de Ciudad Juárez,
  - Instituto Politécnico Nacional (IPN, México DF),
  - Instituto Nacional de Astrología, Óptica y Electrónica (INAOE, Puebla),
  - Universidad Veracruzana (UV, Xalapa VER),
  - Centro de Física Aplicada y Tecnología Avanzada (CFATA-UNAM - Campus Juriquilla, Querétaro, QRO.)

# FORDECyT project started 2010



Sandia  
National  
Laboratories

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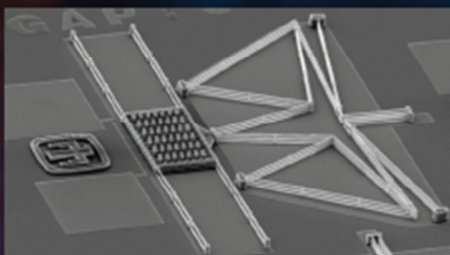


Centro de Investigación en Ciencia y Tecnología Aplicada,

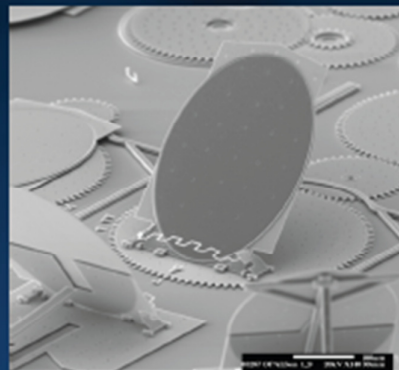
## Training Super-Users in Sandia by 2009



# Summit-V process from Sandia NL



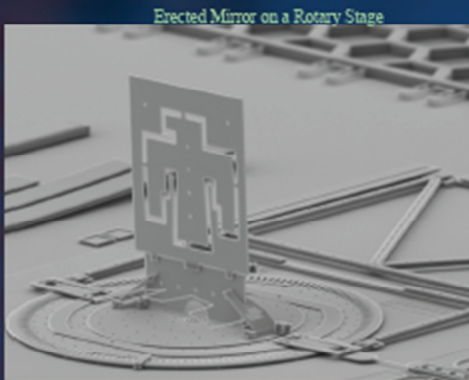
Compliant Displacement Multiplier Mechanism



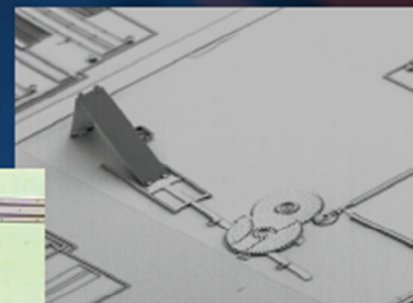
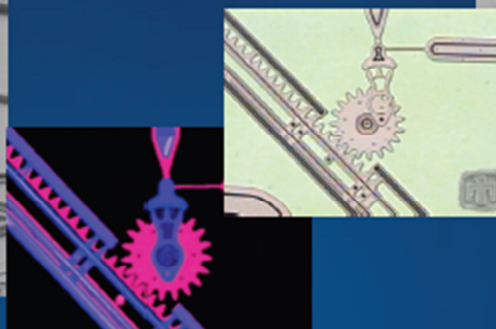
Optical Programmable Array Logic



Rotary Indexing Actuator



Erected Mirror on a Rotary Stage



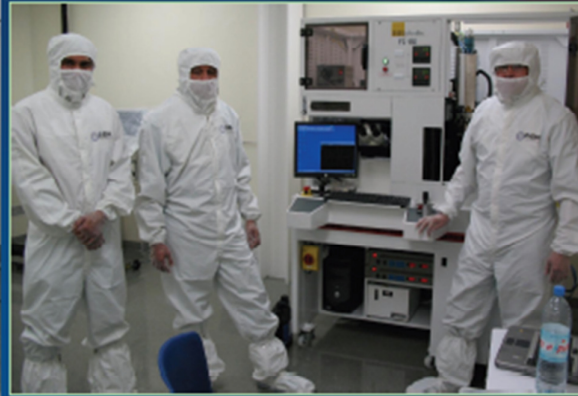
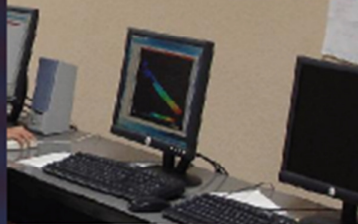
Pop-up Mirror, 1996

# CICTA's Infrastructure in MEMS Technology

Lab. Packaging and test

Lab. Electronic Microscopy

Design of MEMS



## New 6" line manufacturing equipment for MEMS packaging

Suss MicroTec

### FC150

Flip chip bonder  
Die-wafer Bonder  
Optoelectronic assy  
Photonics assy

Disco High Tec

### DAD 3220

Disco wafer dicing  
for up to 6" wafers

Suss MicroTec

### BA6

Aligner  
for 2" – 6" wafers

Suss MicroTec

### SB6e

Wafer-wafer Bonder  
Anodic Bonder  
Eutectic Bonder  
Fusion Bonder  
Thermo compression





## CICTA's Pending Infrastructure (to arrive by Summer 2010)



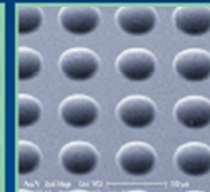
### Microtech's LaserWriter LW405



Test pattern on 0.5  $\mu\text{m}$  thick photoresist. The narrowest lines are 0.8  $\mu\text{m}$  wide, with an edge roughness below 0.2  $\mu\text{m}$ .



Detail of a grey-level LDW mask for Diffractive Optics. The pixel size is  $2 \times 2 \mu\text{m}$ .



Microlens array obtained by grey-level exposure on photoresist. Each lens is 60  $\mu\text{m}$  wide and 5  $\mu\text{m}$  thick.

0.8, 2 or 4  $\mu\text{m}$  linewidth



Centro de Investigación en Ciencia y Tecnología Aplicada, April 27, 2011



*RTP and conventional Furnaces Critical dimension measuring system including ellipsometer and resistivity mapping system installed at INAOE.*

*0.5 $\mu$ m mask making system installed at Instituto Nacional de Astrofísica Óptica y Electrónica (INAOE).*

## Infraestructura at INAOE, Puebla

Started in 1974.

fabricación de Circuitos Integrados (CIs)  
Bipolar, NMOS & CMOS

10 um from 1974 - 2008

BiCMOS 0.8 um started 2009

### SERVICIOS TECNOLÓGICOS

Diseño de Circuitos Integrados  
Diseño de MEMS  
Diseño y Fabricación de Mascarillas  
Fabricación de prototipos de MEMS  
Fabricación de Circuitos Integrados  
Caracterización Funcional de MEMS a nivel oblea  
Centro de Entrenamiento:  
Tecnología de Microelectrónica  
MEMS



Centro de Investigación en Ciencia y Tecnología

# INSTITUTO NACIONAL DE ASTROFÍSICA, ÓPTICA Y ELECTRÓNICA LABORATORIO DE INNOVACIÓN EN MEMS

INAUGURACIÓN 19 ABRIL 2010



Se tiene el objetivo de consolidar una infraestructura de fabricación en alta tecnología que aglutine a los científicos del país y dirija con un enfoque multidisciplinario hacia la investigación e innovación en tecnología de Nanoelectrónica y MEMS/NEMS. Establecer una plataforma tecnológica que dé soporte a la formación de recursos humanos altamente calificados e impulse el desarrollo de la industria electrónica nacional.

#### CARACTERÍSTICAS

600m<sup>2</sup> de sala clase 10 y 100  
Equipo de fabricación con obleas de 6 pulgadas  
Desarrollo de un proceso BiCMOS de 0.8 um  
Fabricación de sensores, actuadores y MEMS  
Microsajinado Superficial y de Volumen  
Aplicaciones analógicas y digitales  
Dispositivos TBT de heteroestructura  
Materiales Nanoestructurados

#### MINI COLOQUIO 19 - 20 ABRIL

**Dr. Jamal Deen**  
McMASTER UNIVERSITY, CANADA

**Dr. Cor L. Claeys**  
IMEC, BÉLGICA

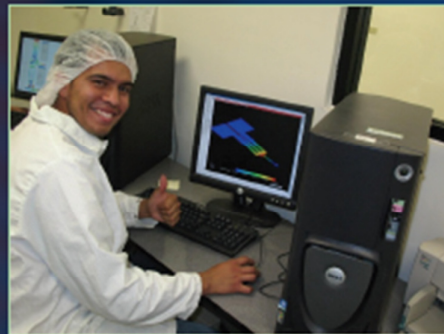
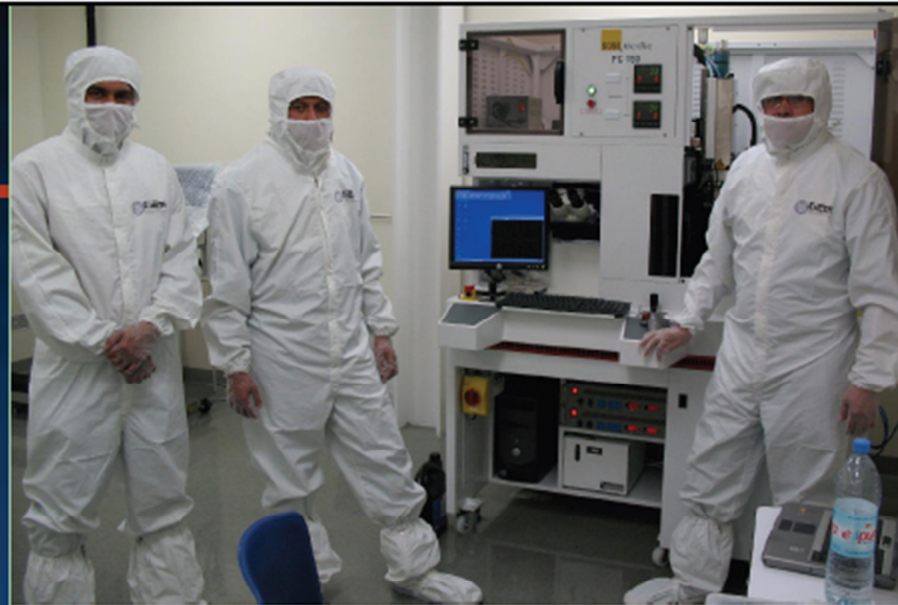
**Dr. Fernando Guarín**  
IBM MICROELECTRONICS, EUA

**Dr. Subramanian S. Iyer**  
IBM MICROELECTRONICS, EUA

**Dr. Rafael Rios**  
INTEL, EUA



Thank you!



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Research Professor

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