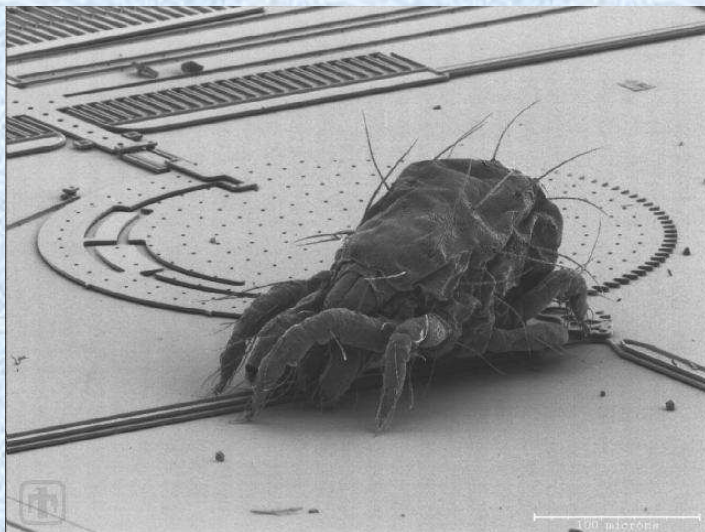


-
-
-
-
-
-
-
-
-
-
-

6. Aplicaciones de los Microsistemas



Juan García Ortega

José M. Quero

Dpto. Ingeniería Electrónica

-
-
-
-
-
-
-
-

-
-
-

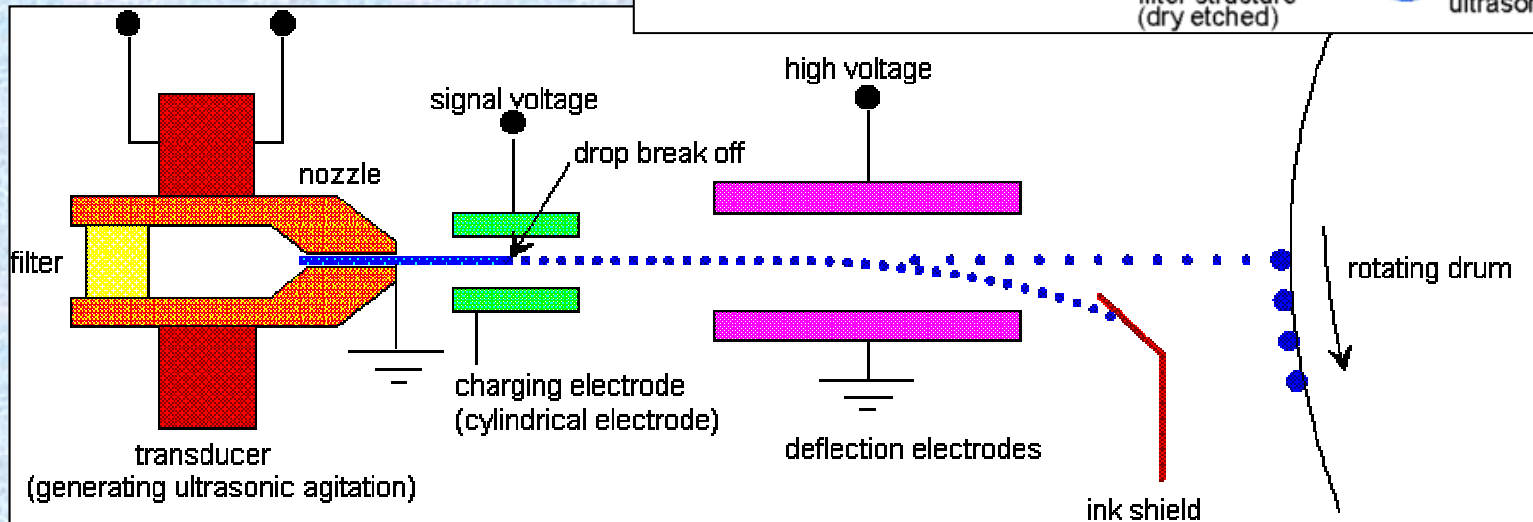
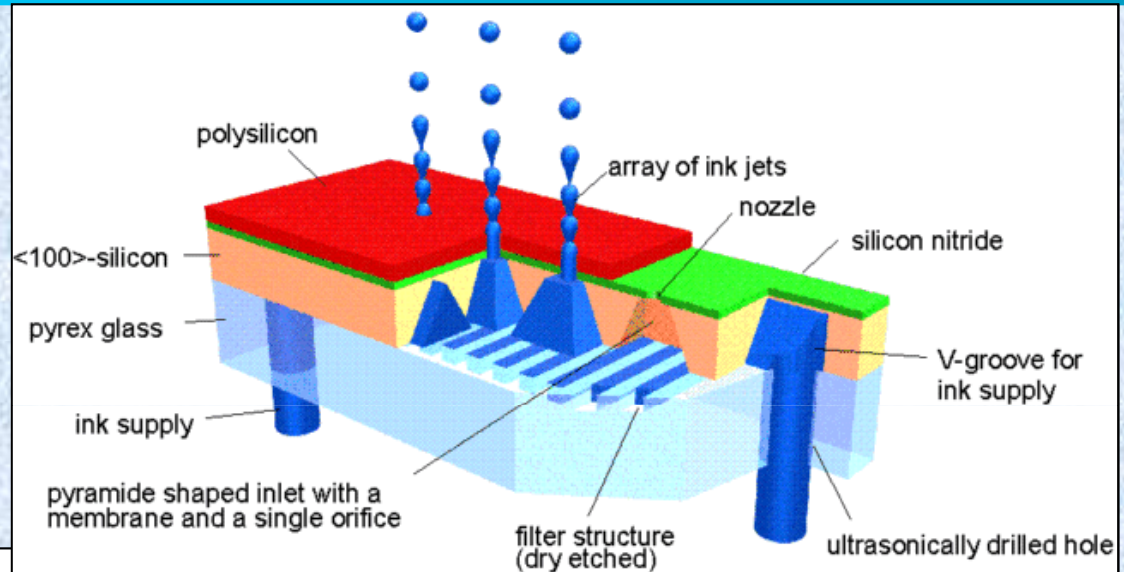
Indice

- Motivación
- Propiedades
- Fabricación
- Ejemplos
- Tendencias

-
-
-

Ejemplos: Actuadores

Inyectores de Tinta

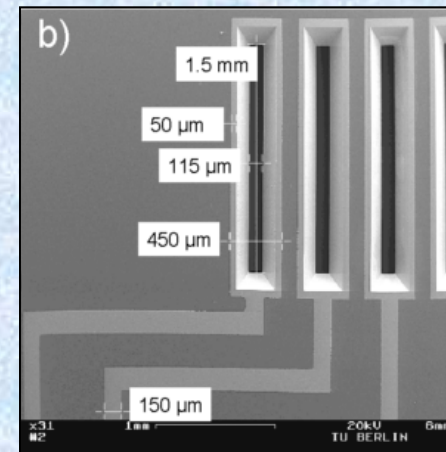
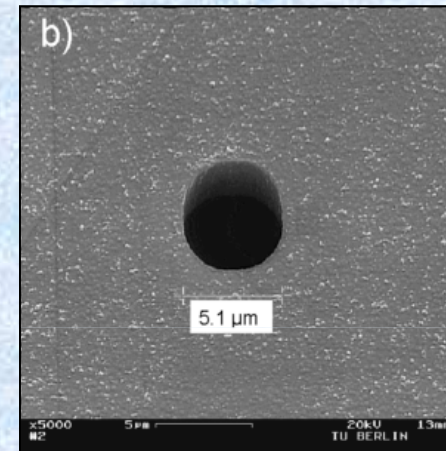
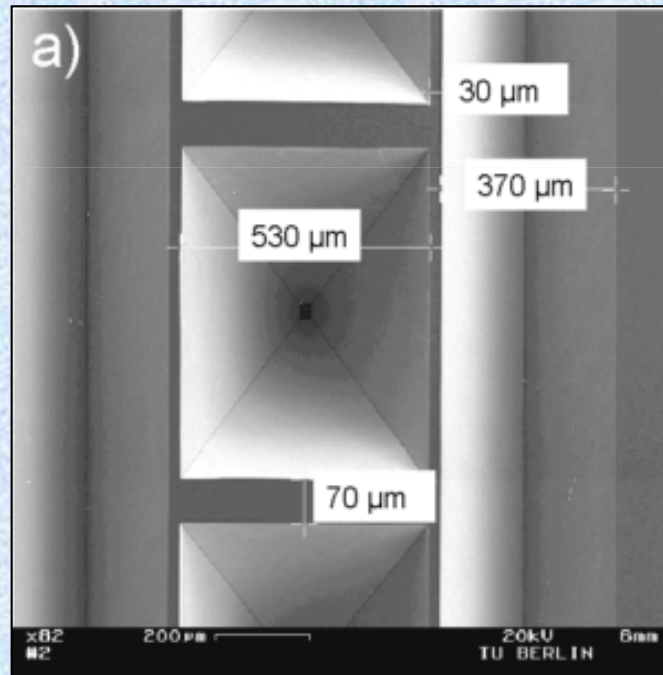


-
-
-
-
-
-
-
-

-
-
-

Ejemplos: Actuadores

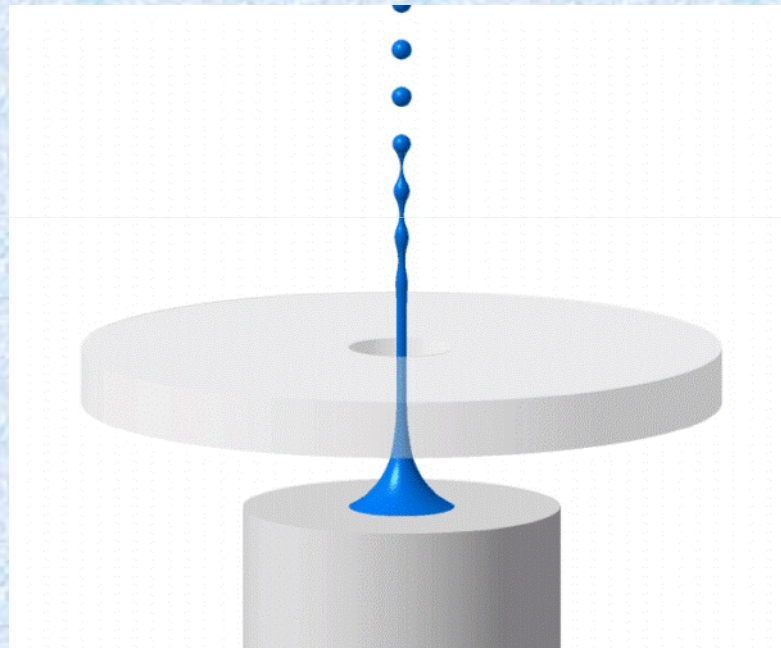
Inyectores de Tinta



-
-
-

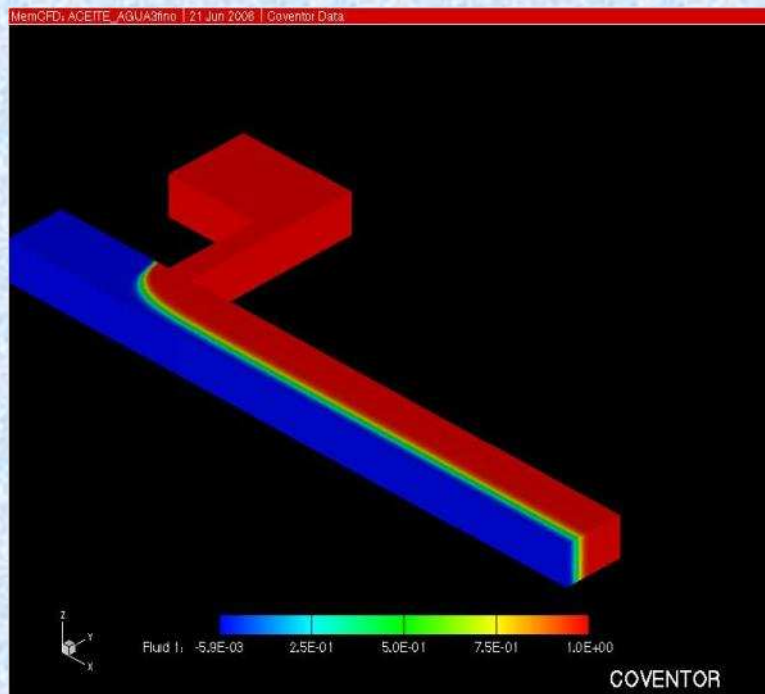
Ejemplos: Flow Focusing

Creación de micropartículas



-
-
-

Ejemplos: Flow Focusing



Simulación con Coventor:

- Microemulsión
- Agua-Aceite
- Modelo Axilsimétrico

-
-
-

Ejemplos: Flujo de proceso

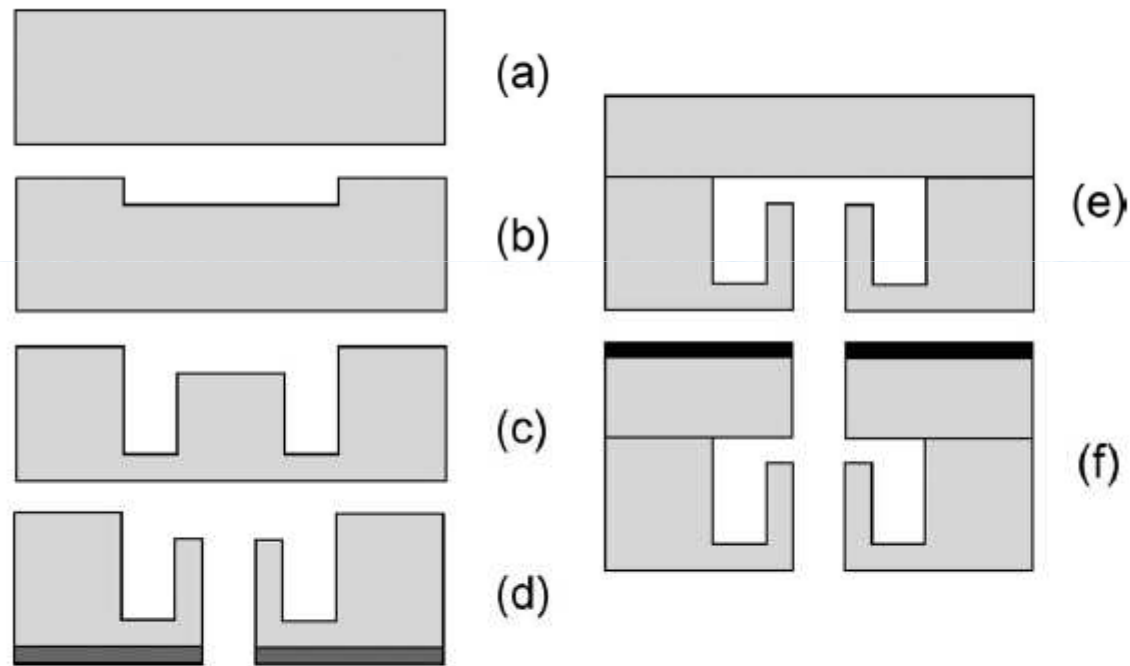
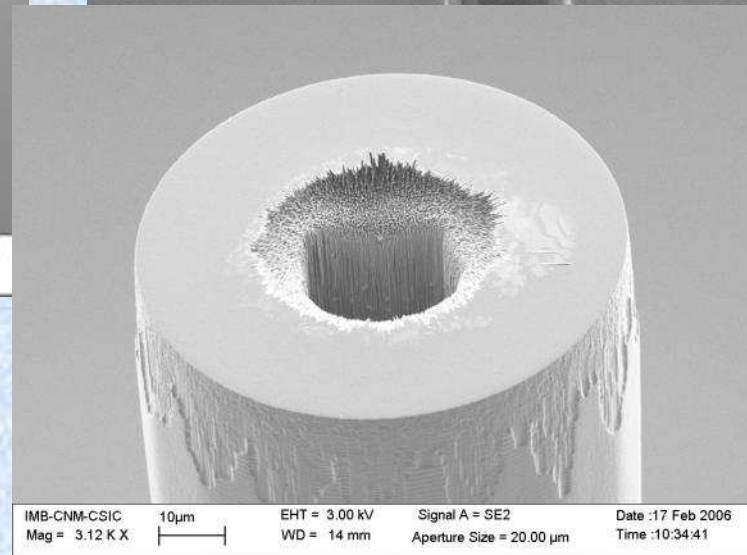
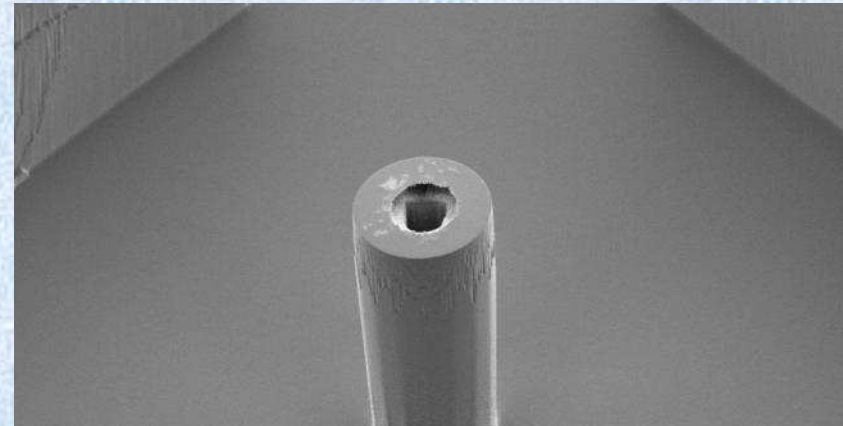
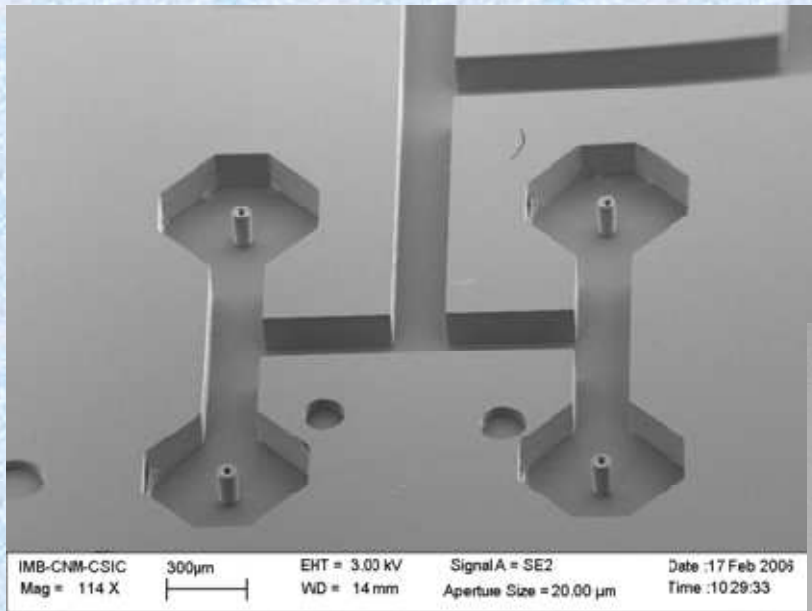


Fig. 3. Fabrication process. (a) Initial wafer. (b) RIE: 10 μm . (c) DRIE: 170 μm . (d) Oxidation and DRIE from back side. (e) Fusion bonding. (f) Al sputtering and photopatterning and RIE of silicon.

-
-
-

Ejemplos: Flow Focusing



Date :17 Feb 2006
Time :10:30:39

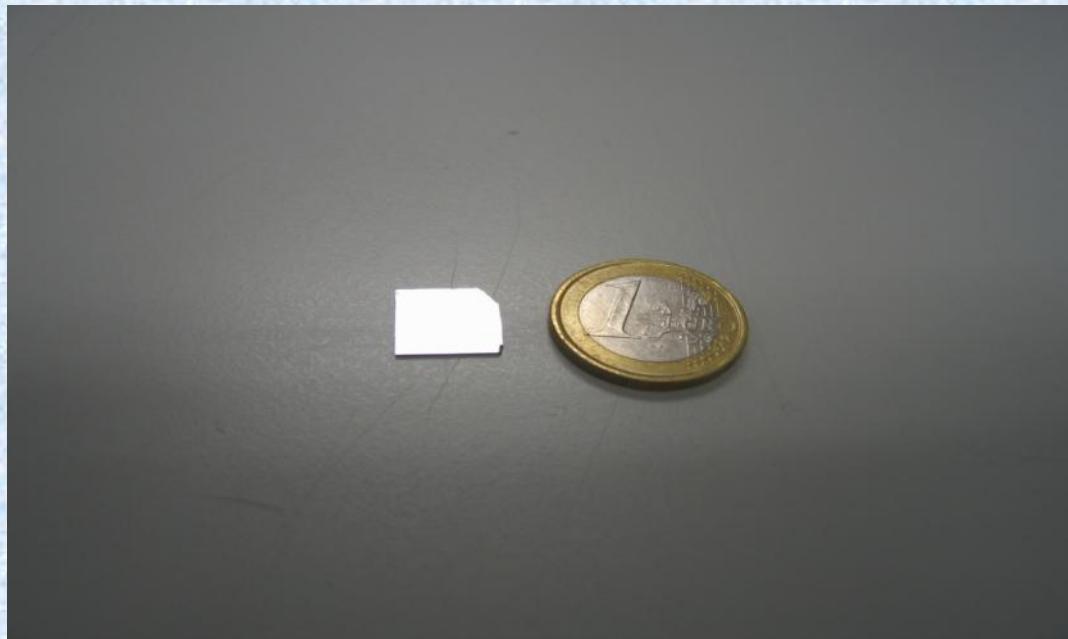
-
-
-
-
-
-
-
-

-
-
-

Ejemplos: Flow Focusing

Chip Flow focusing

- **Tamaño total (12 x 12x 1.04 mm), con 64 salidas**
- **Diámetro salidas = 50 μm**

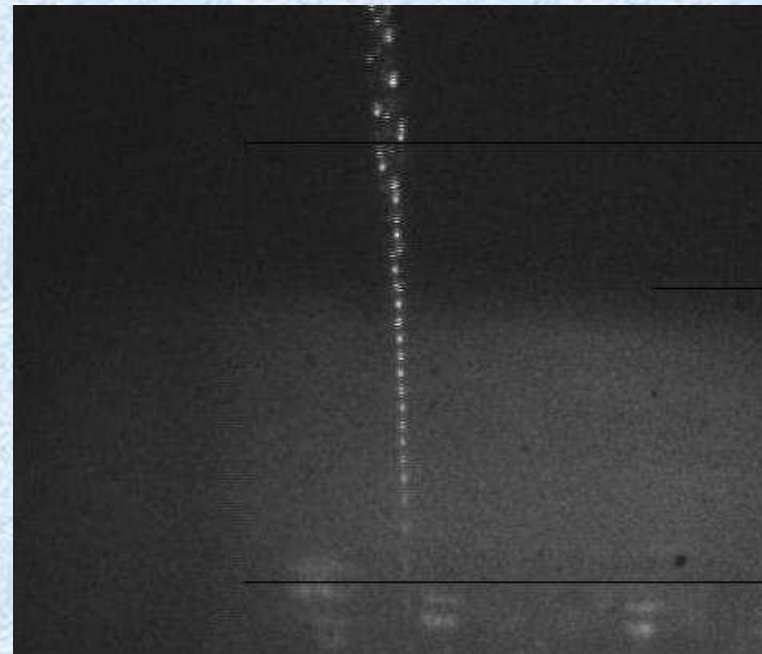


-
-
-

Resultados Experimentales



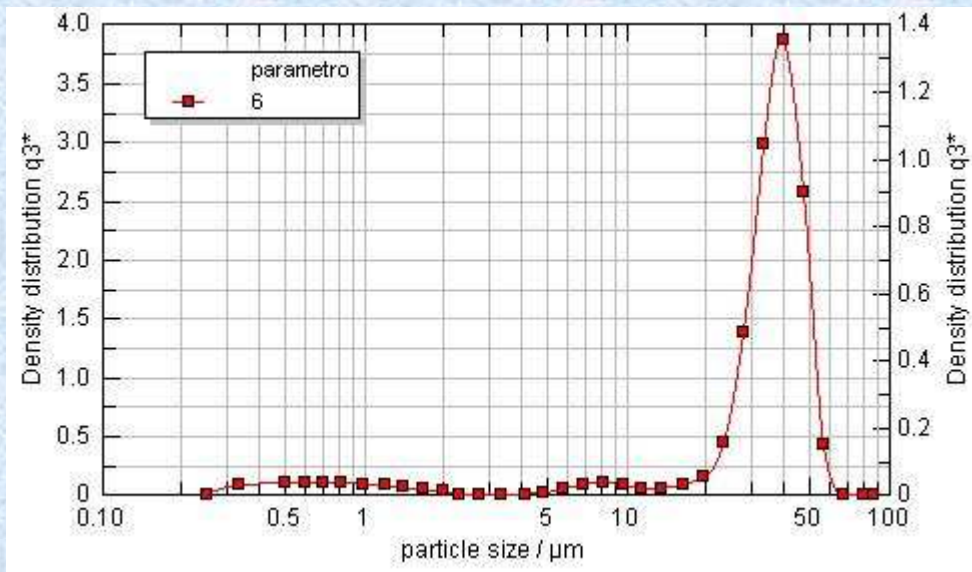
Isooctano en agua



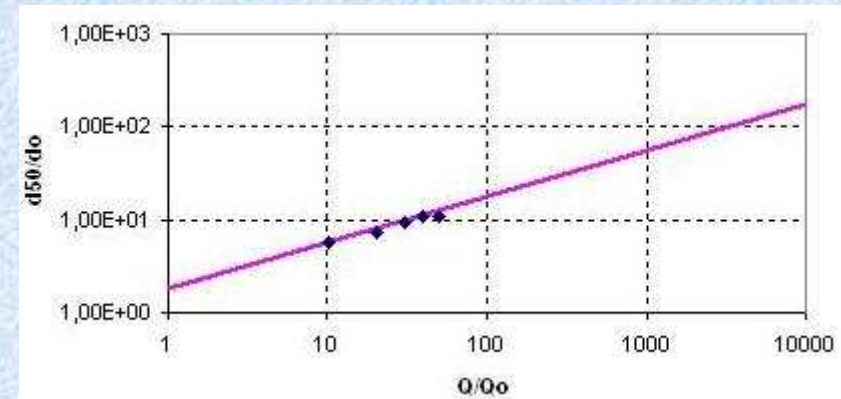
Microburbujas

-
-
-

Flow Focusing



Monodispersión



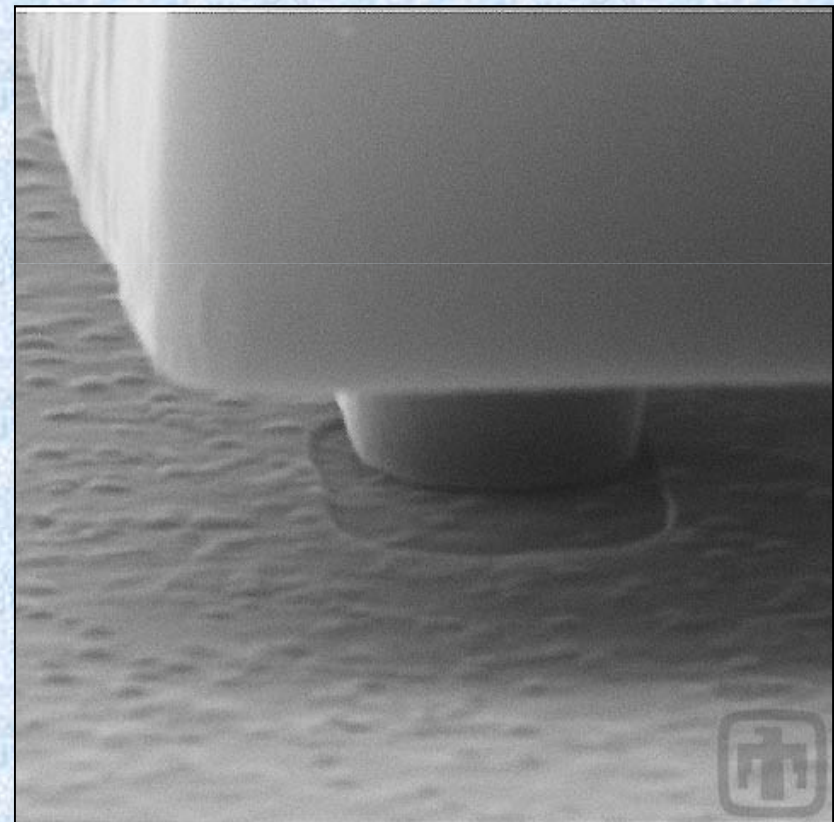
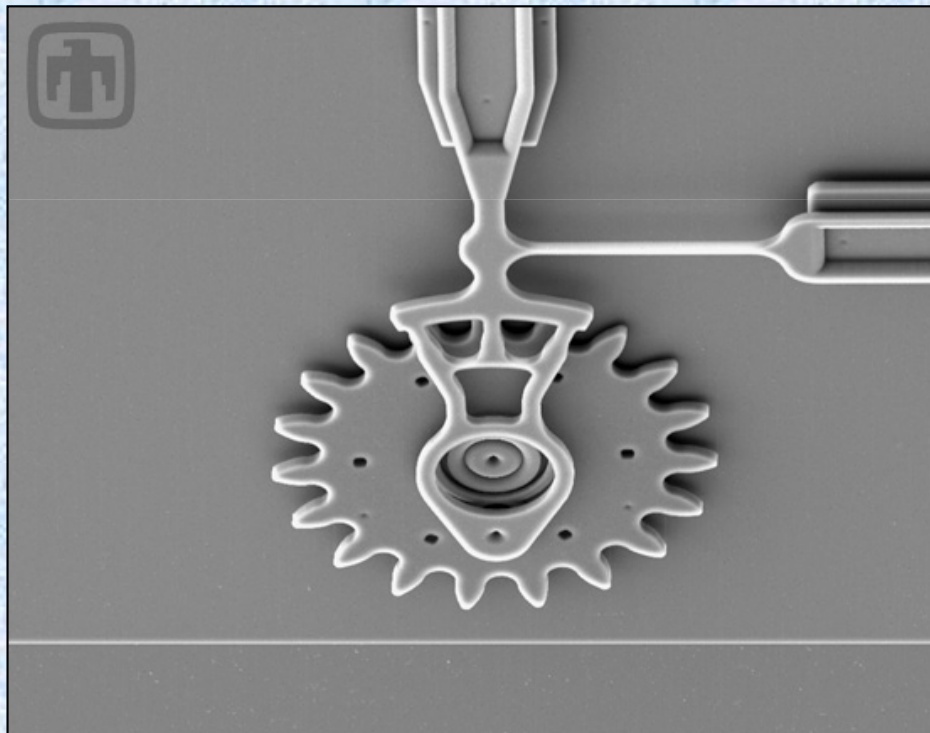
Tamaño de gota respecto caudal

-
-
-
-
-
-
-
-

-
-
-

Ejemplos: Actuadores

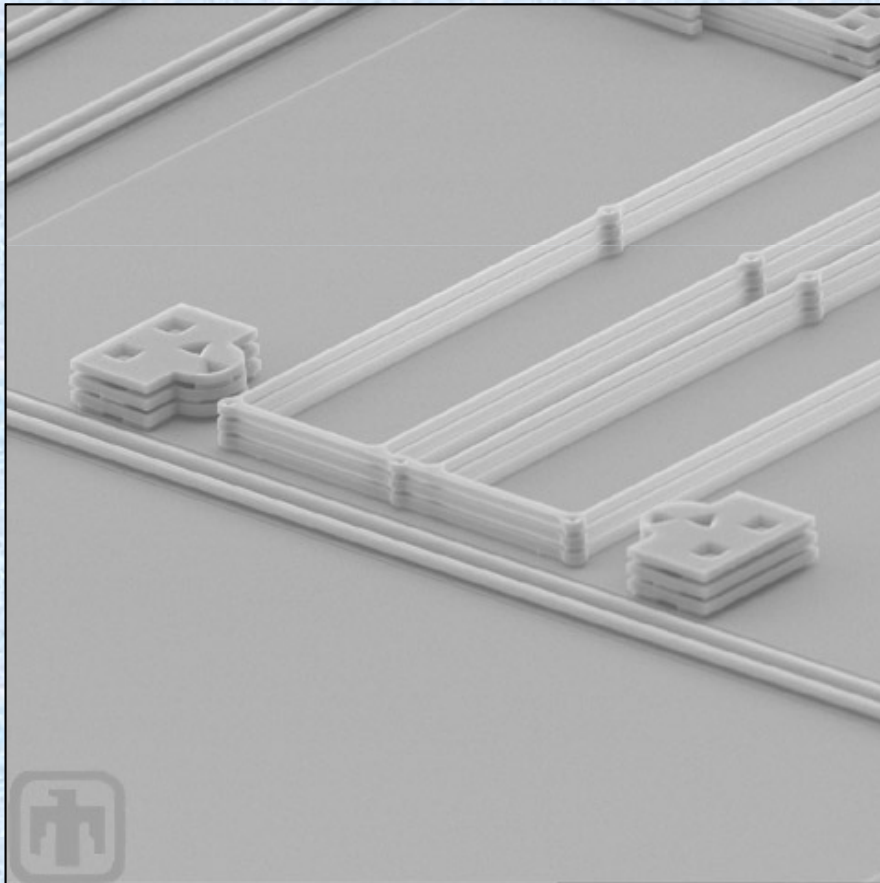
Mecanismos



-
-
-

Ejemplos: Actuadores

Mecanismos

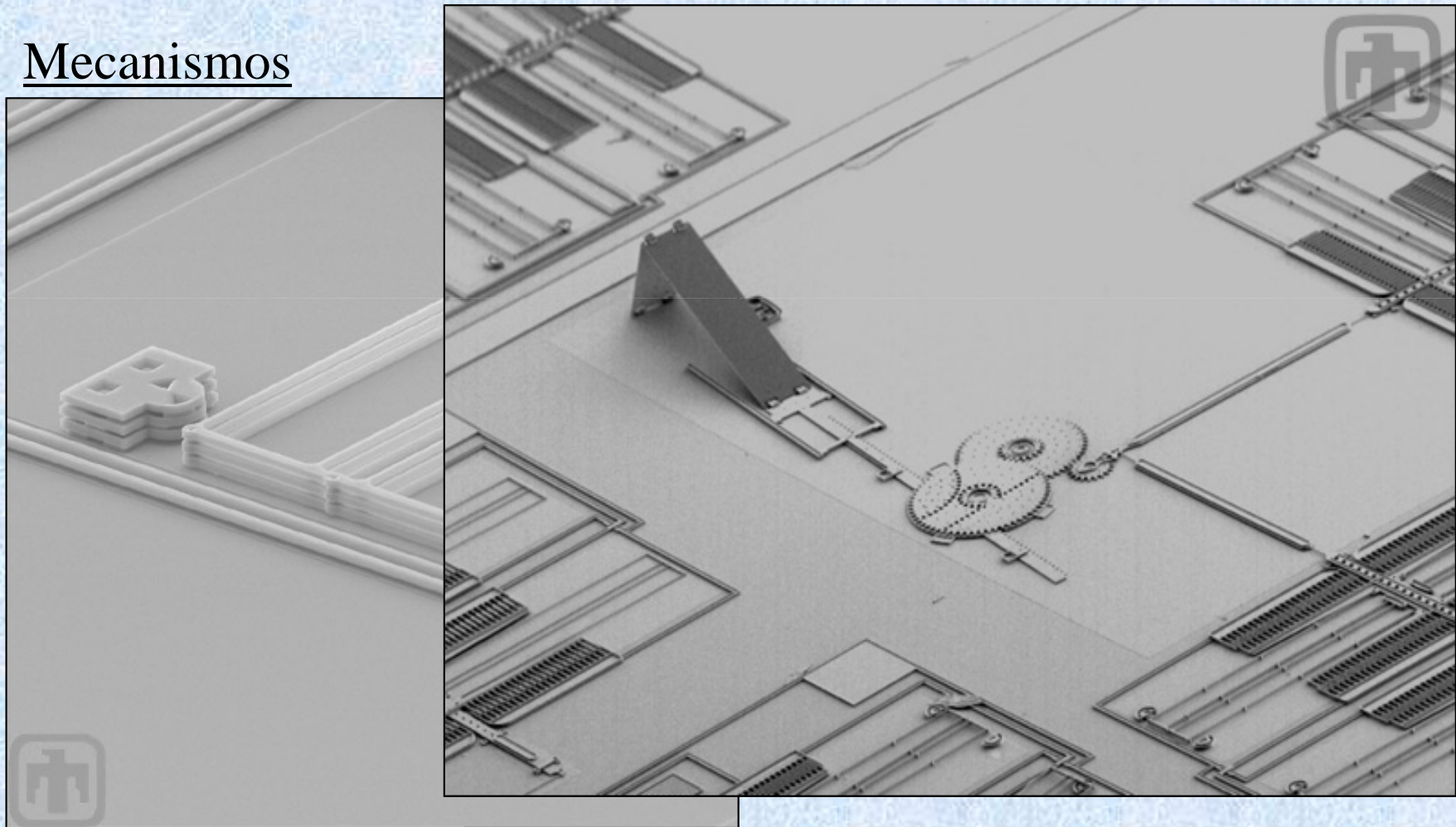


-
-
-
-
-
-
-
-

-
-
-

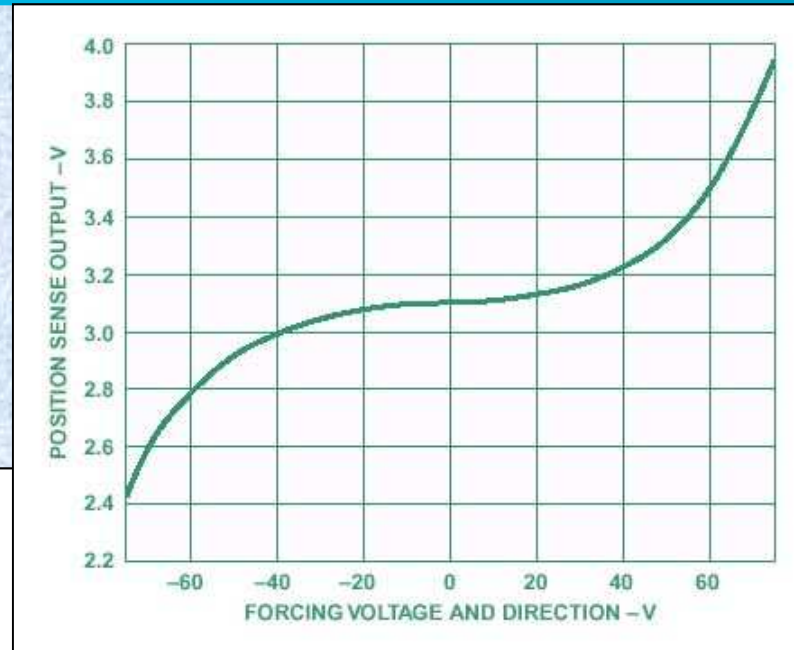
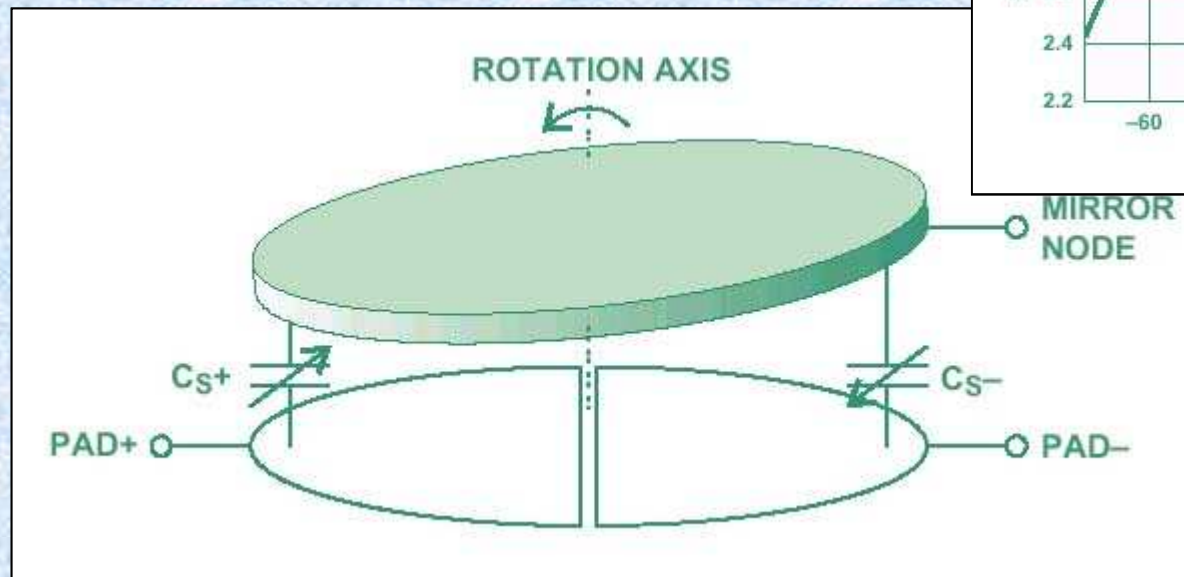
Ejemplos: Actuadores

Mecanismos



Óptica

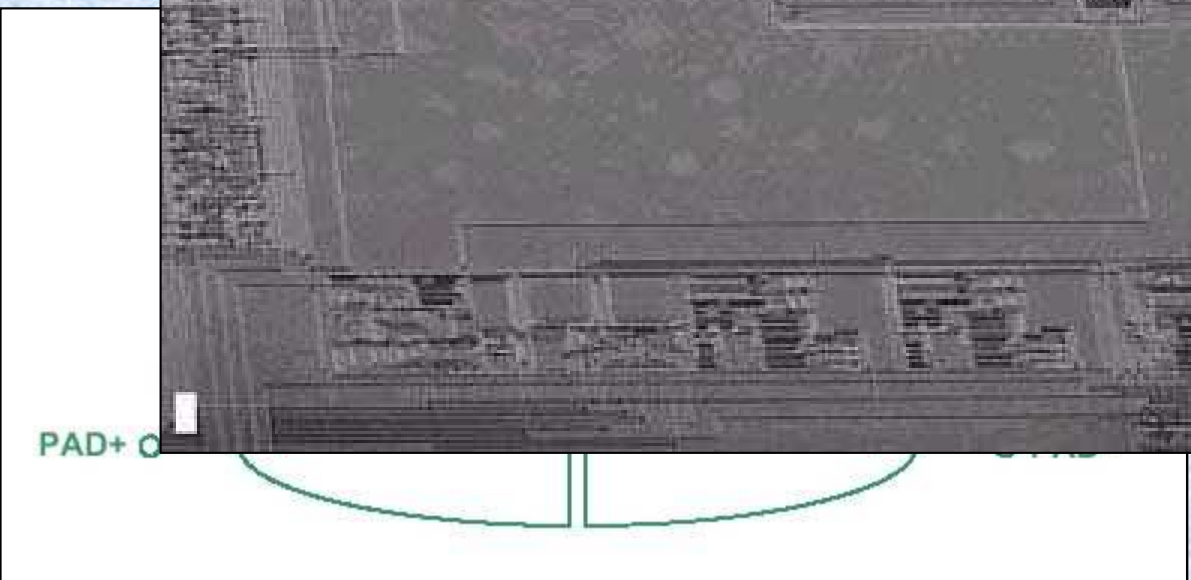
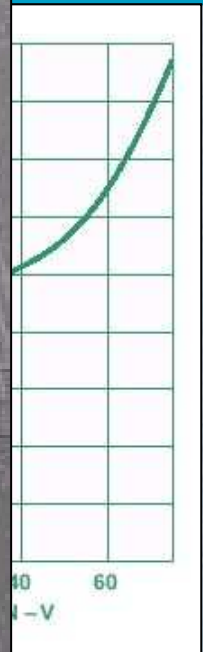
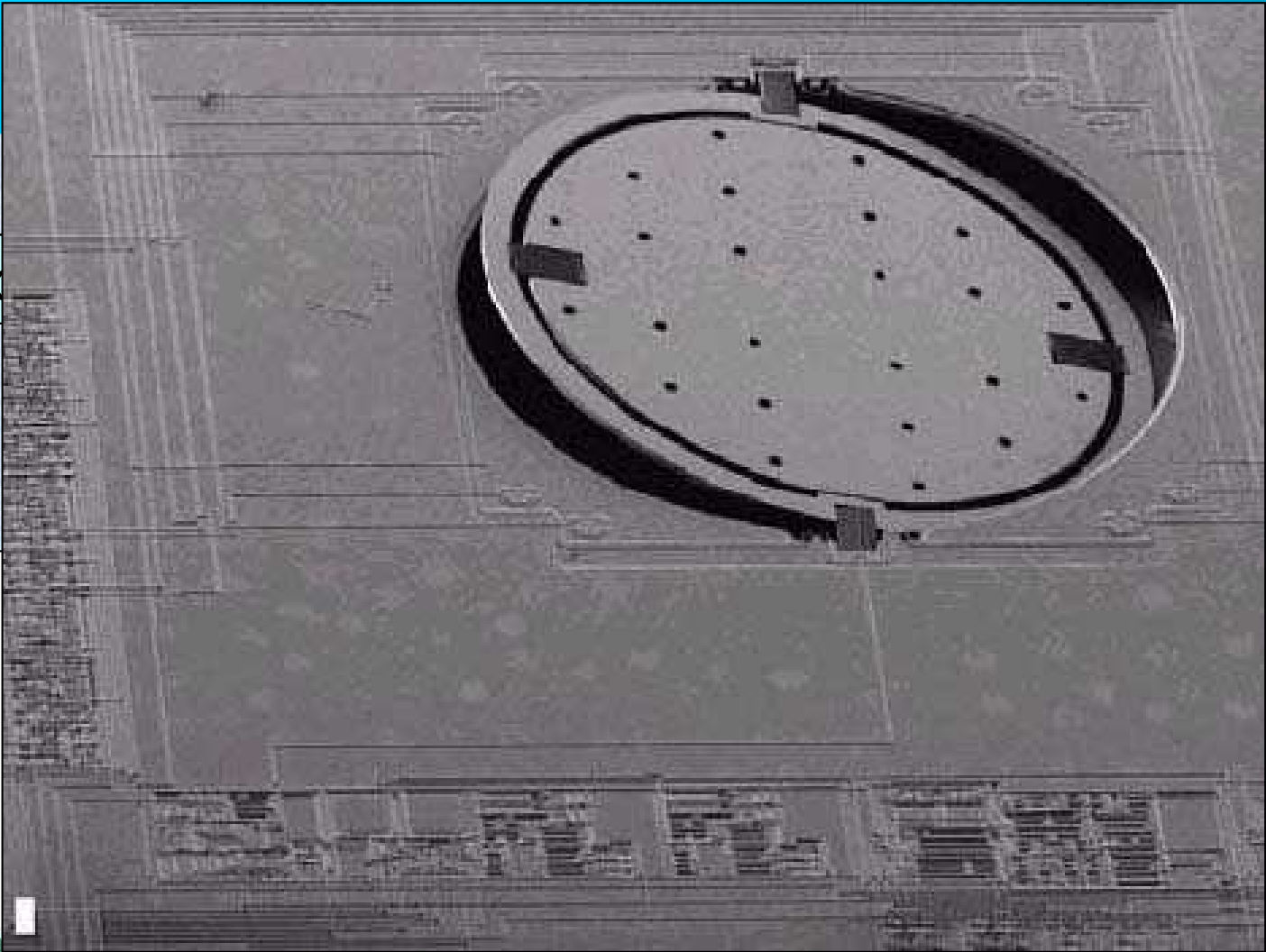
Conmutadores ópticos



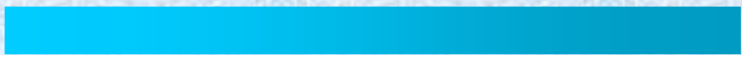
-
-
-



Co



PAD+ C



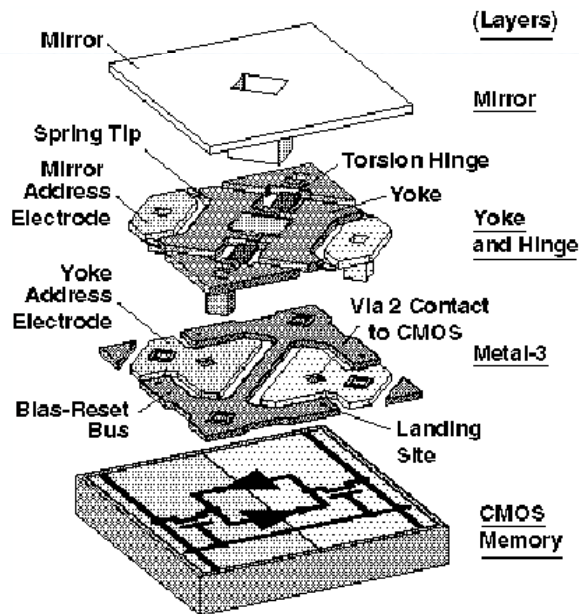
-
-
-
-
-
-
-
-
-

-
-
-

Ejemplos: Actuadores

Digital Micro Devices (DMD) (Texas Instruments)

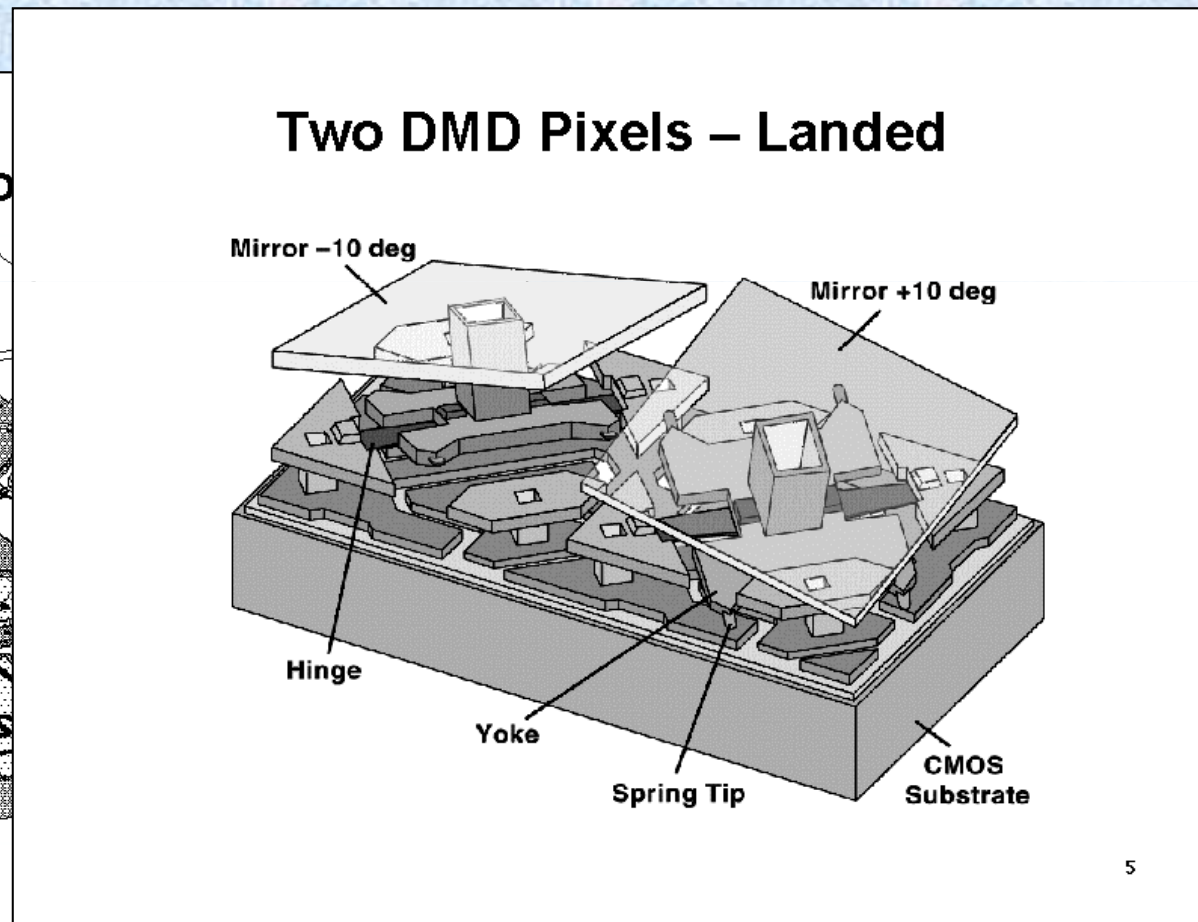
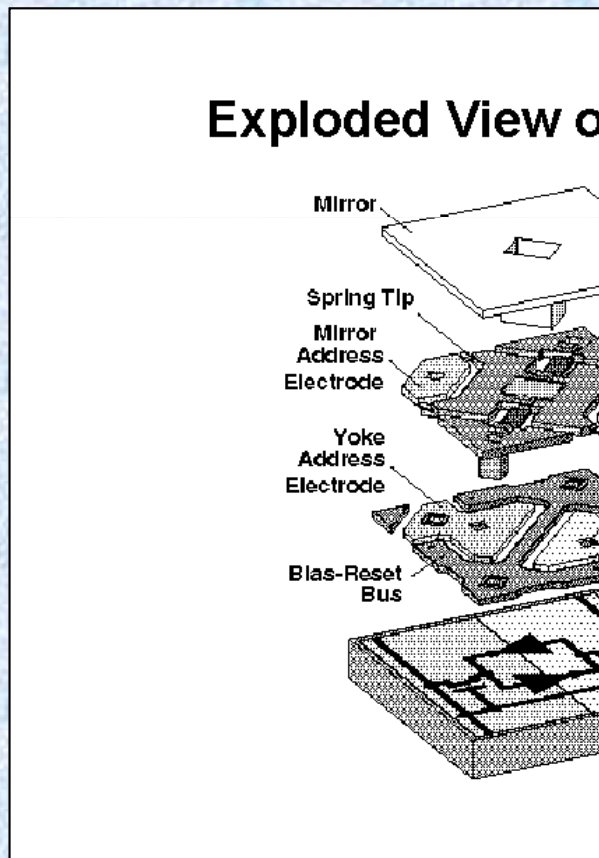
Exploded View of a DMD Pixel



-
-
-

Ejemplos: Actuadores

Microespejos



-
-
-
-
-
-
-
-

-
-
-

Ejemplos: Actuadores

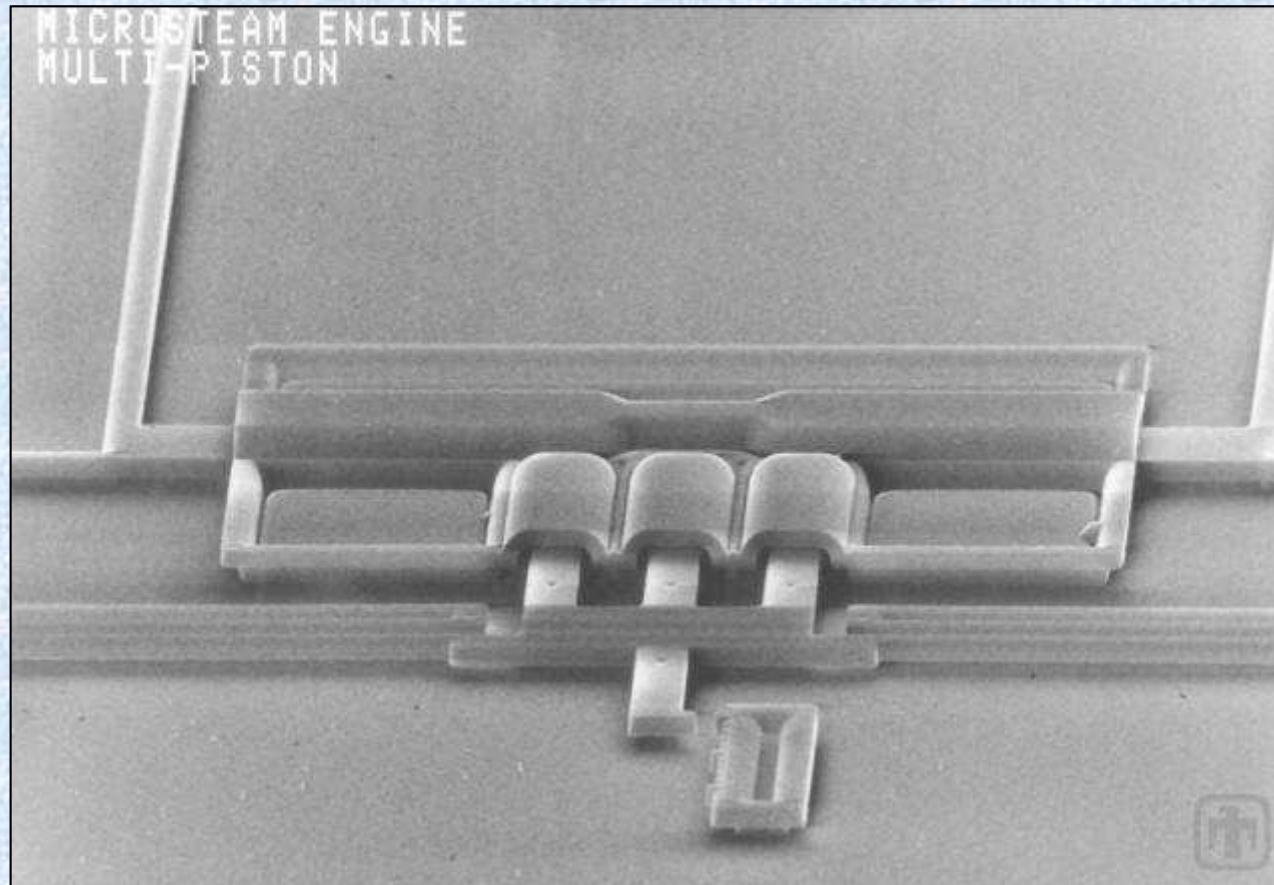
Microespejos



-
-
-

Ejemplos: Actuadores

Micromotores a vapor



-
-
-

Ejemplos: Actuadores

Micromoturbinas

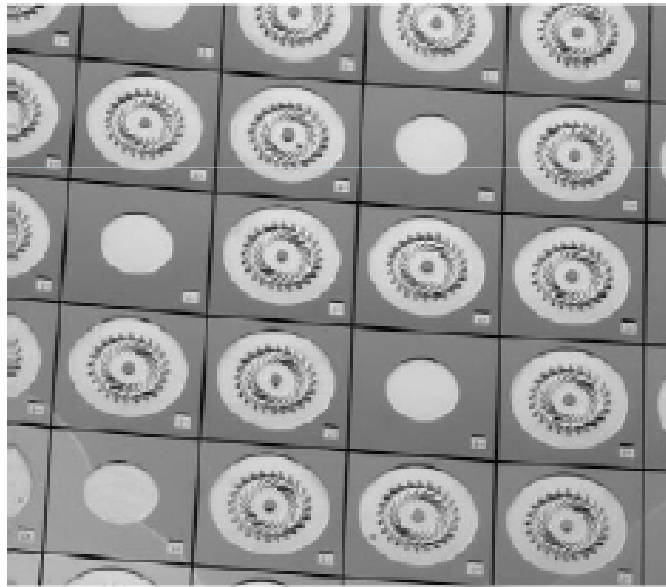


Figure 5: Si water of radial inflow turbine stages.

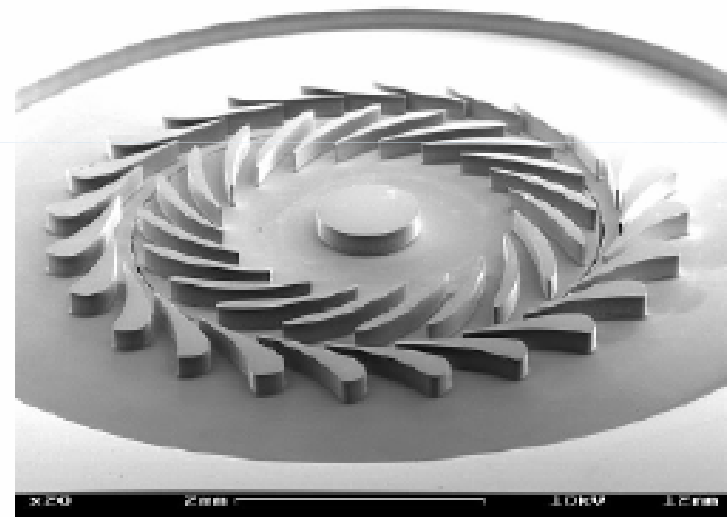
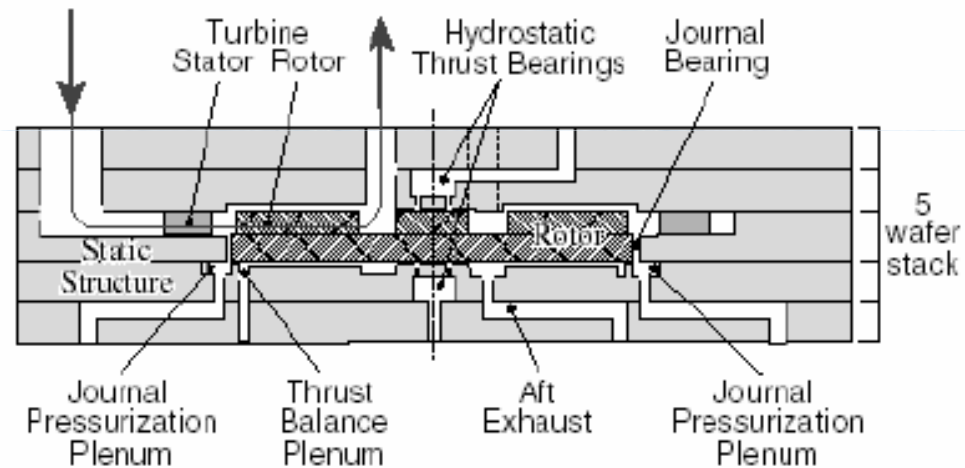


Figure 6: A 4:1 pressure ratio, 4 mm rotor dia radial inflow turbine stage.

-
-
-

Ejemplos: Actuadores

Micromoturbinas



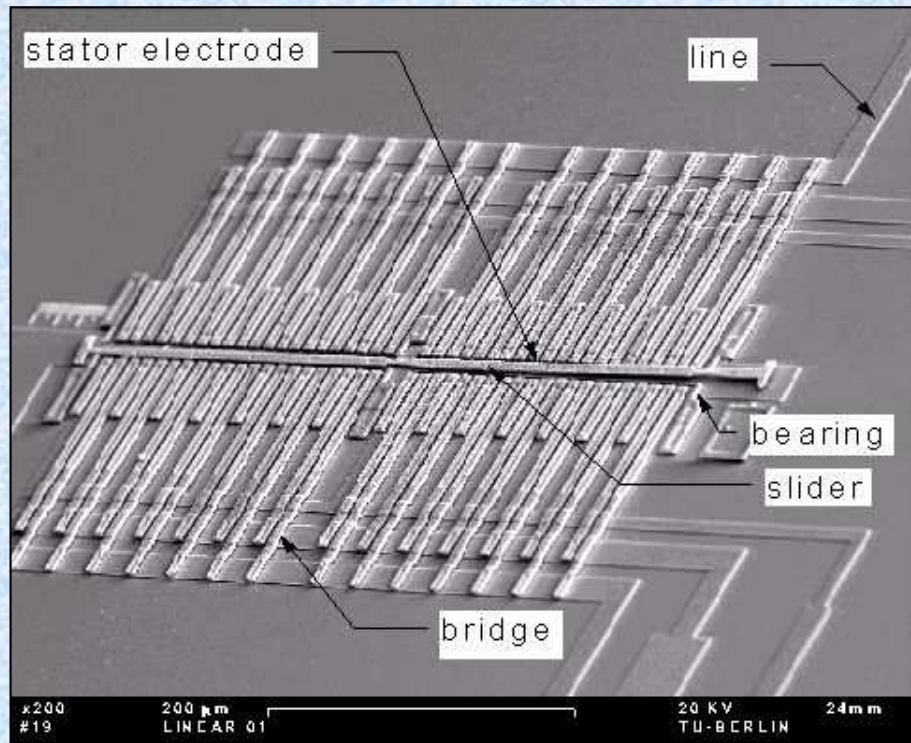
(a) Conceptual Cross-Section

Figure 8: Complete, 5-layer turbine "stack" including bearings and fluid plumbing.

-
-
-

Ejemplos: Actuadores

Micromotores electrostáticos

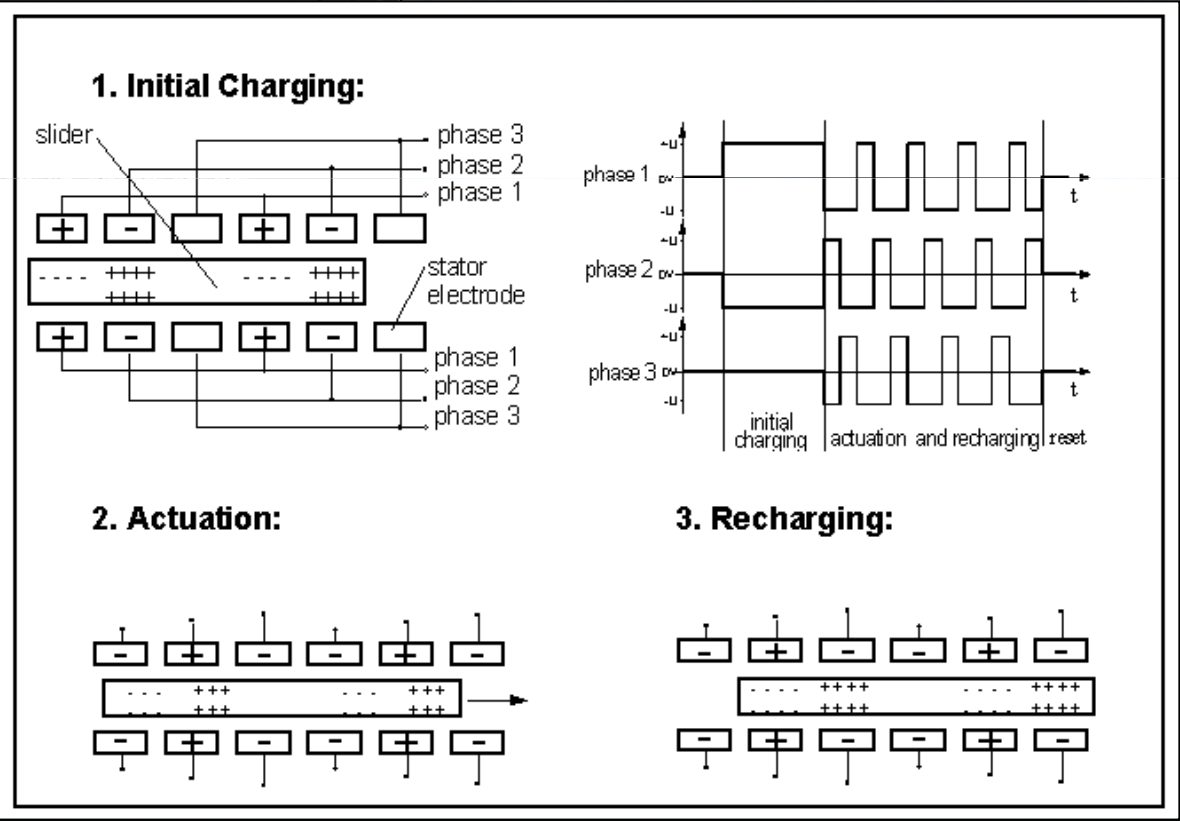
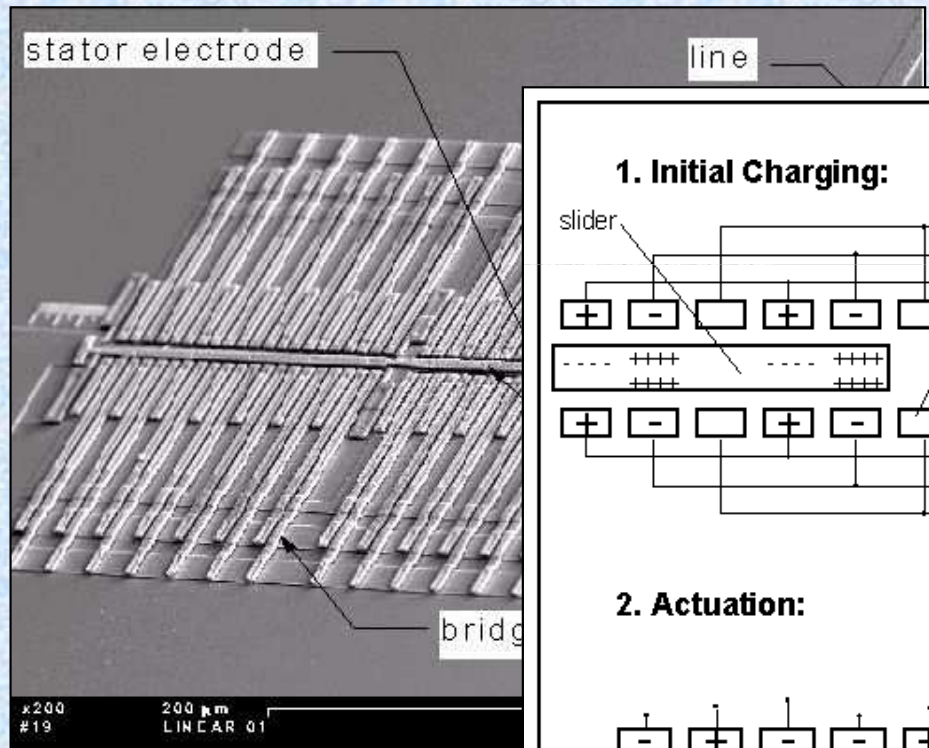


-
-
-
-
-
-
-
-
-

-
-
-

Ejemplos: Actuadores

Micromotores electrostáticos

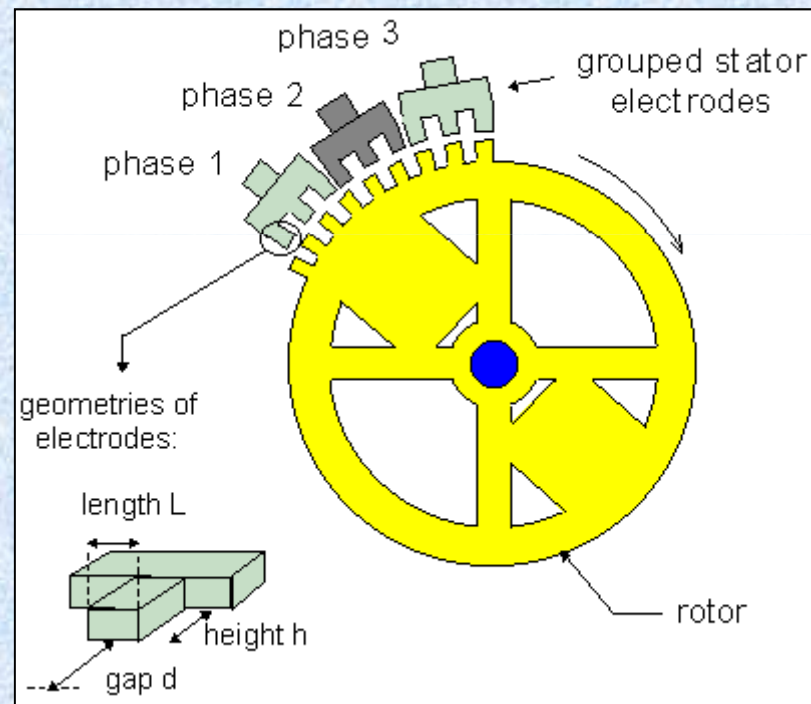
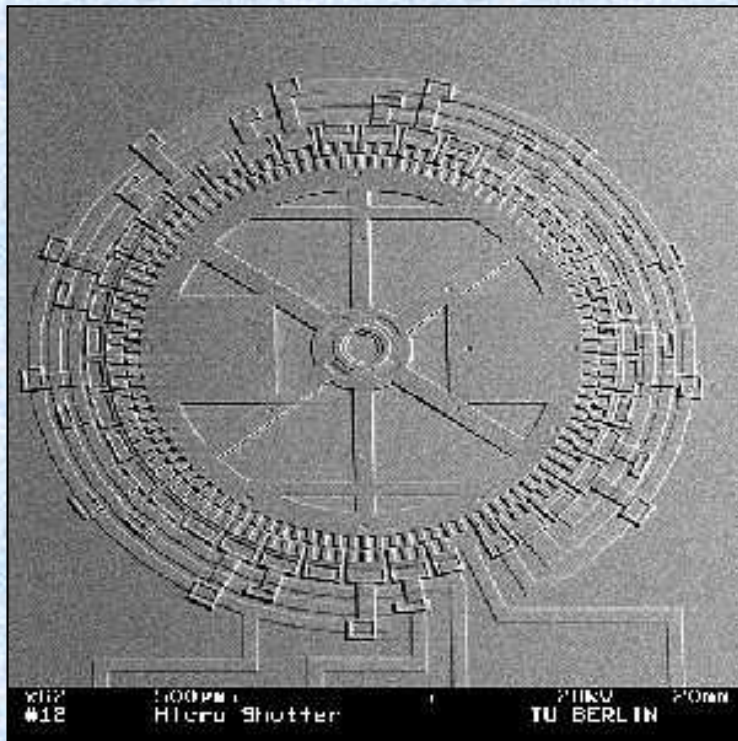


-
-
-
-
-
-
-
-

-
-
-

Ejemplos: Actuadores

Micromotores electrostáticos



-
-
-
-
-
-
-
-

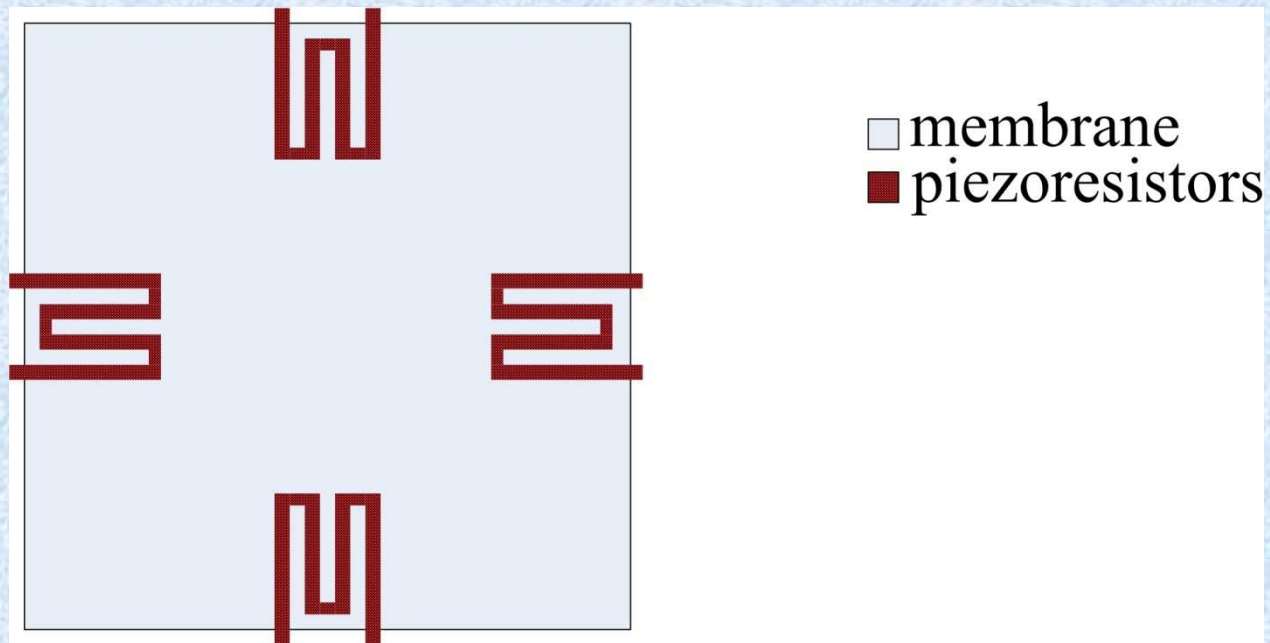
-
-
-

Indice

- Motivación
- Propiedades
- Fabricación
- Ejemplos
 - Actuadores
 - Sensores
- Tendencias

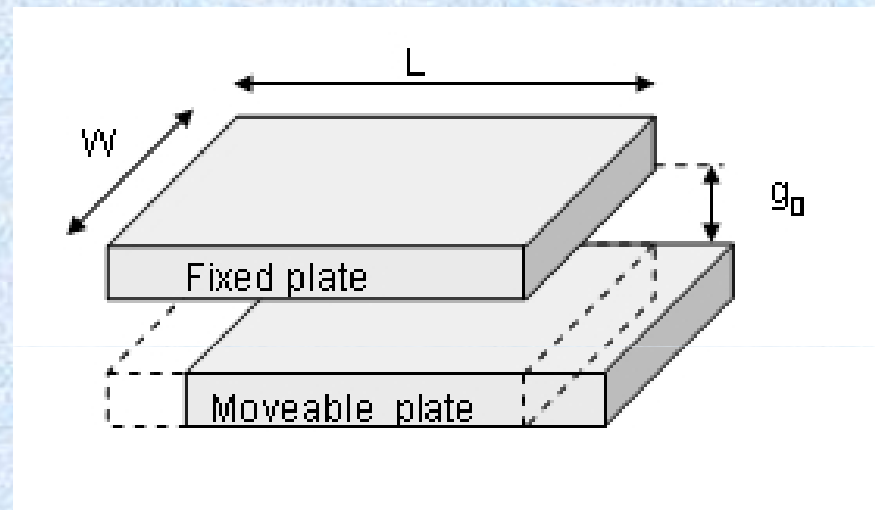
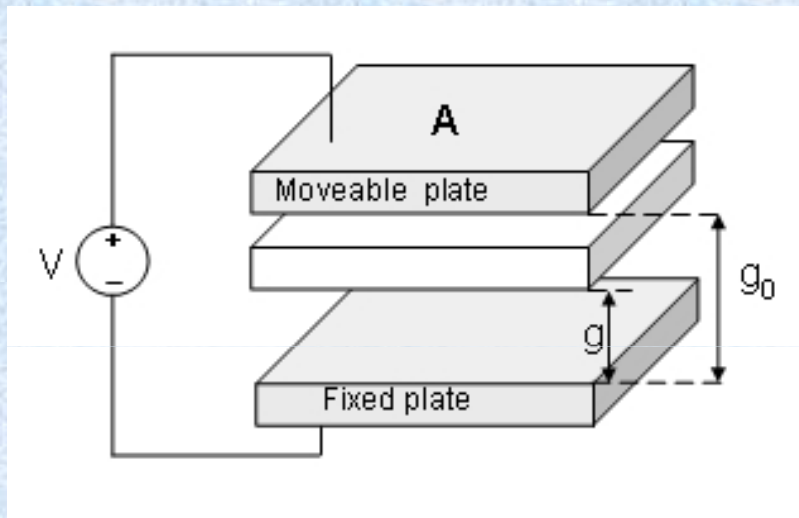
-
-
-

Sensores resistivos



-
-
-

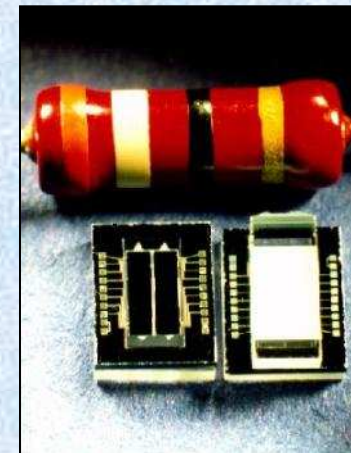
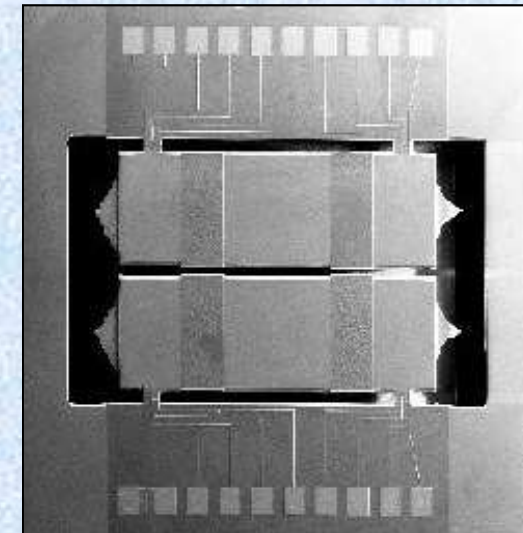
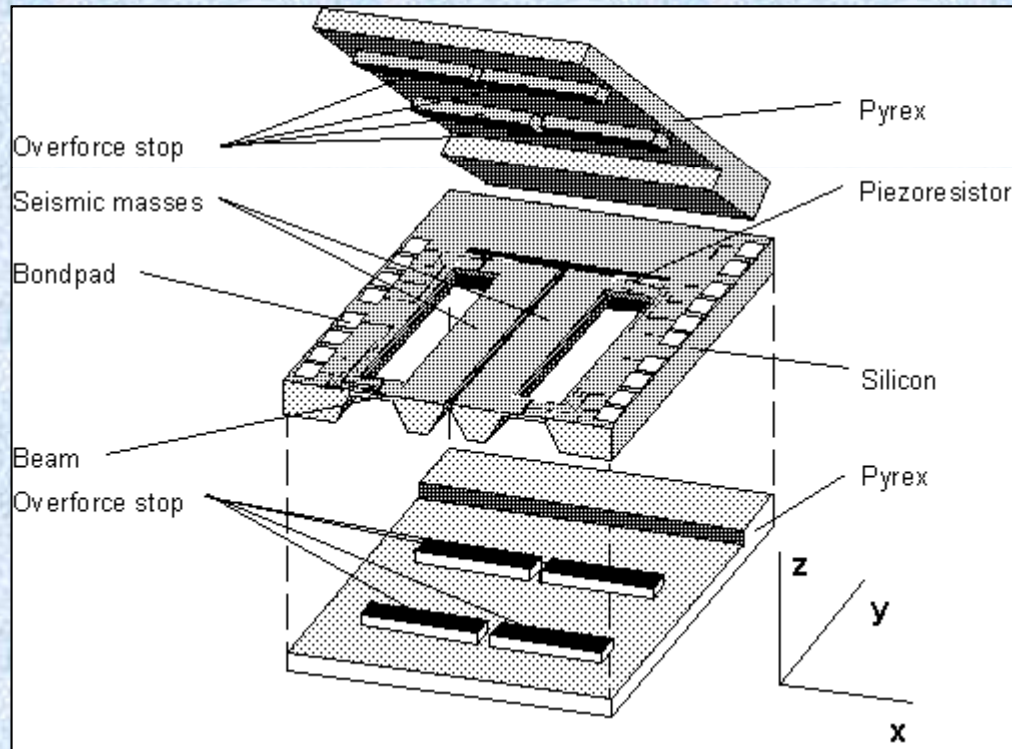
Sensores capacitivos



-
-
-

Ejemplos: Sensores

Acelerómetros

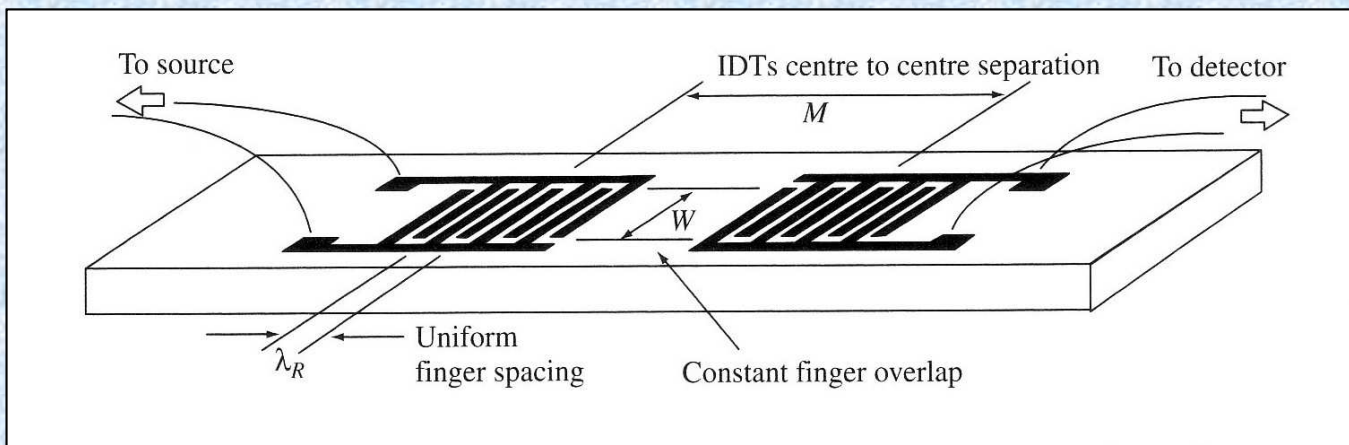
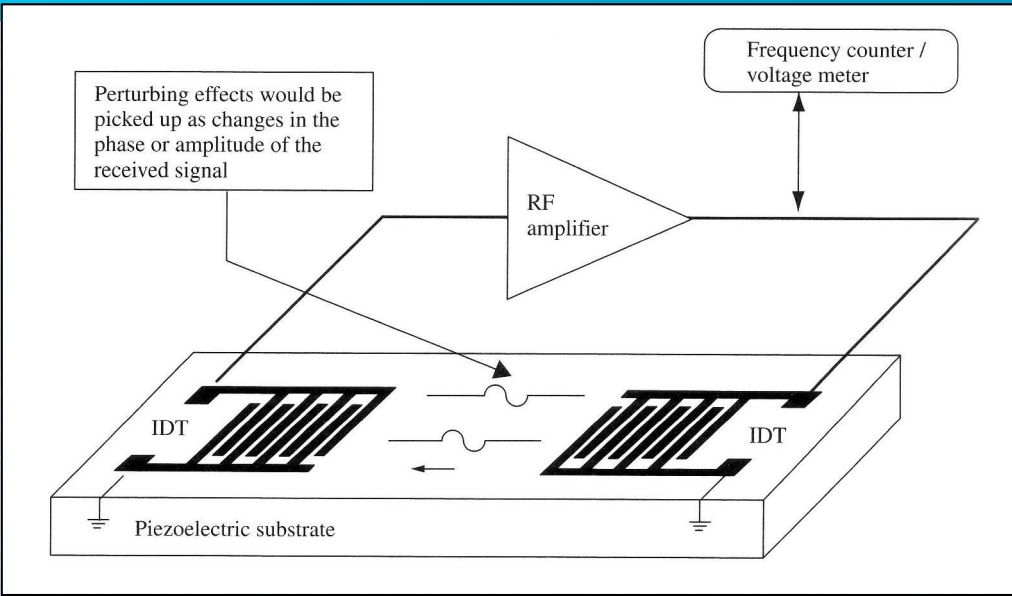


-
-
-
-
-
-
-
-

-
-
-

SAW

Interdigital Transducers

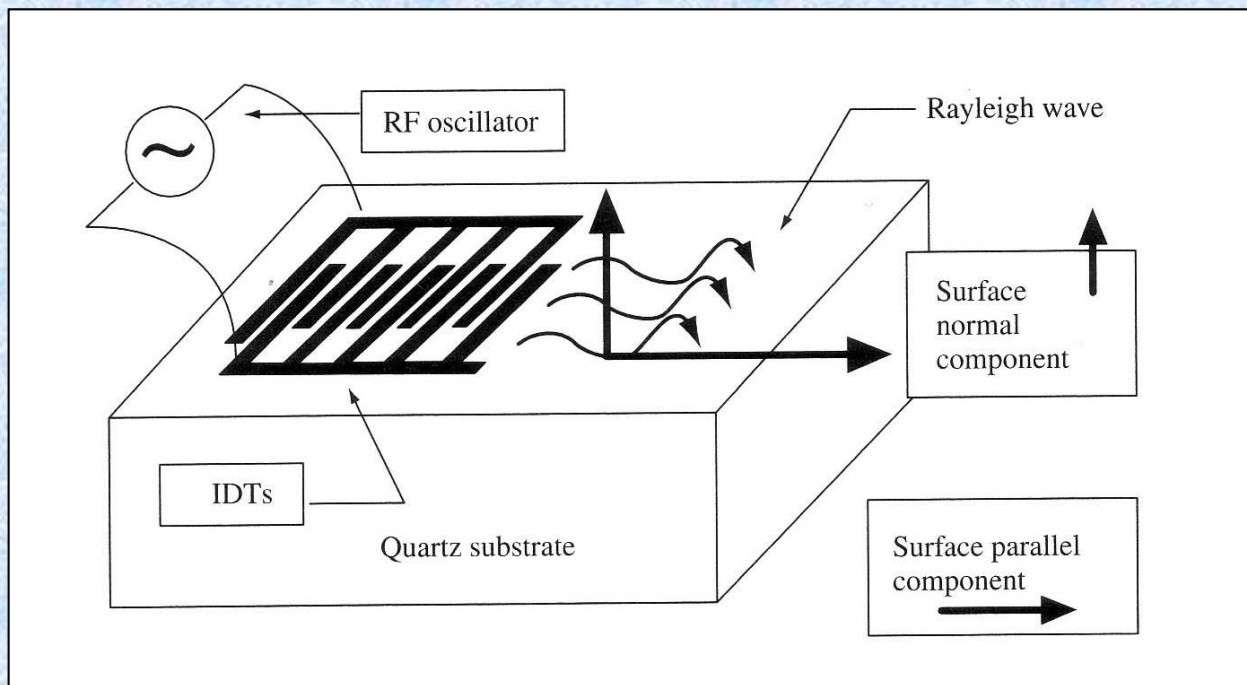


-
-
-
-
-
-
-
-

-
-
-

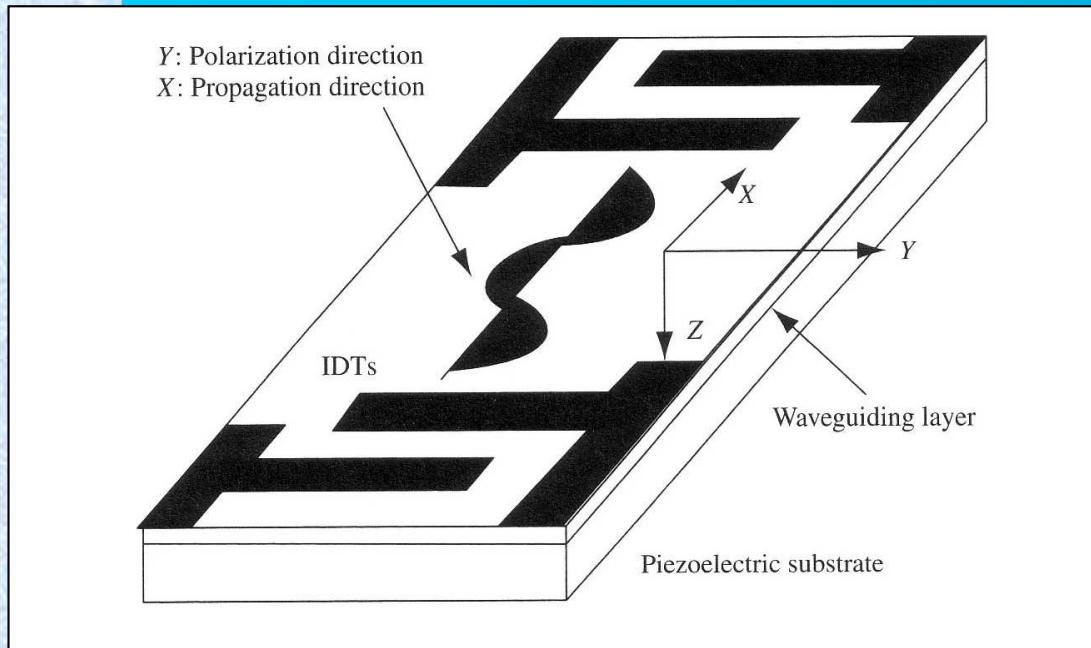
SAW

Tipos de ondas SAW

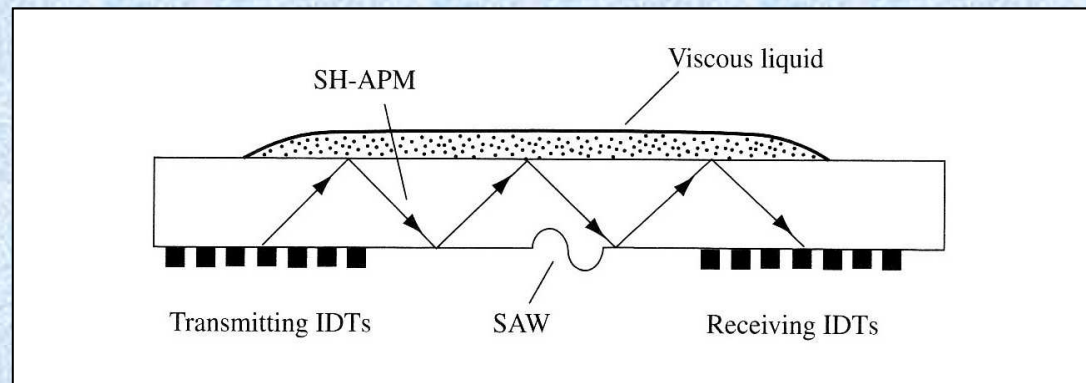


-
-
-

SAW



Tipos
de
ondas SAW

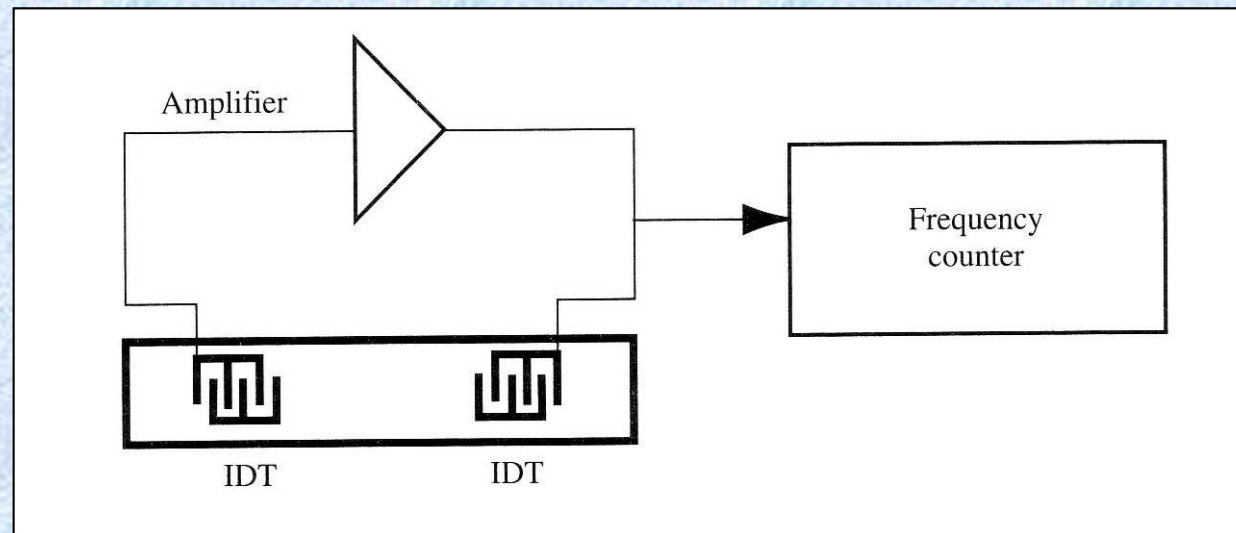


-
-
-
-
-
-
-
-

-
-
-

SAW

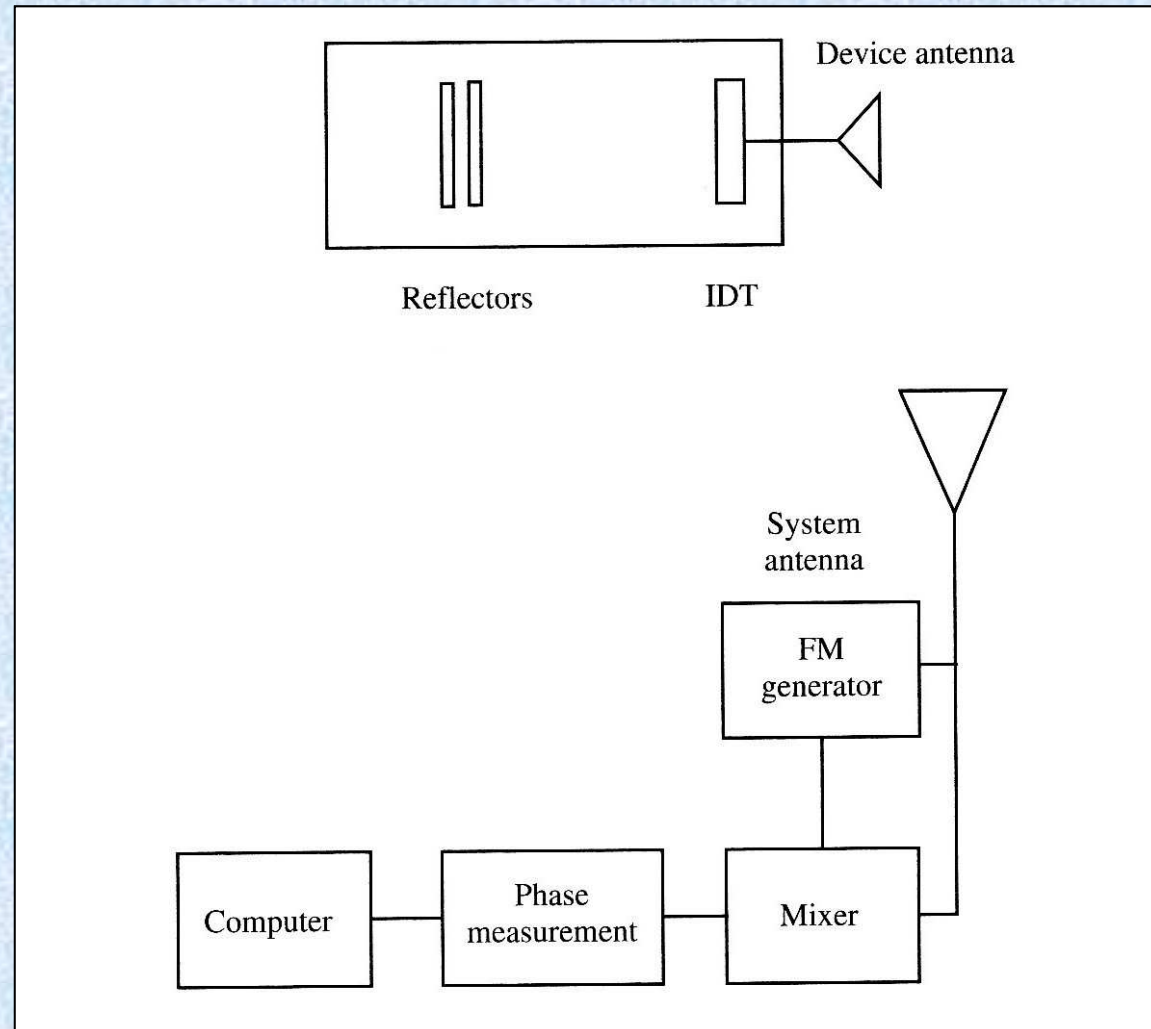
Wireless SAW-based Microsensors



-
-
-

SAW

Wireless
SAW-based
Microsensors

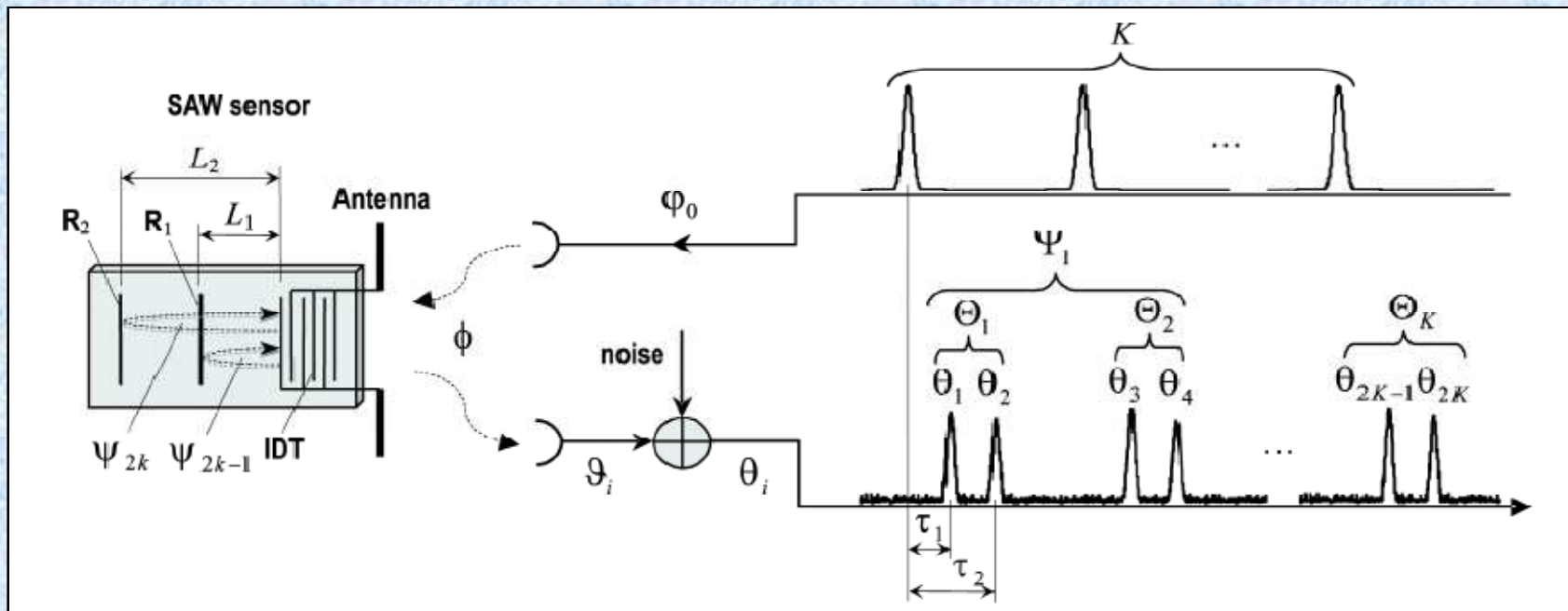


-
-
-
-
-
-
-
-

-
-
-

SAW

Wireless SAW-based Microsensors



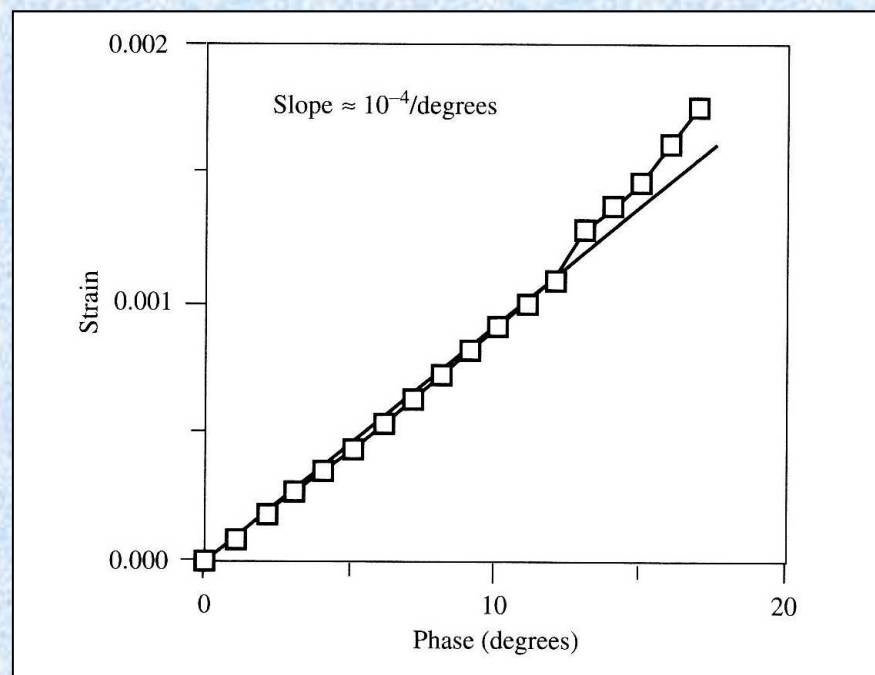
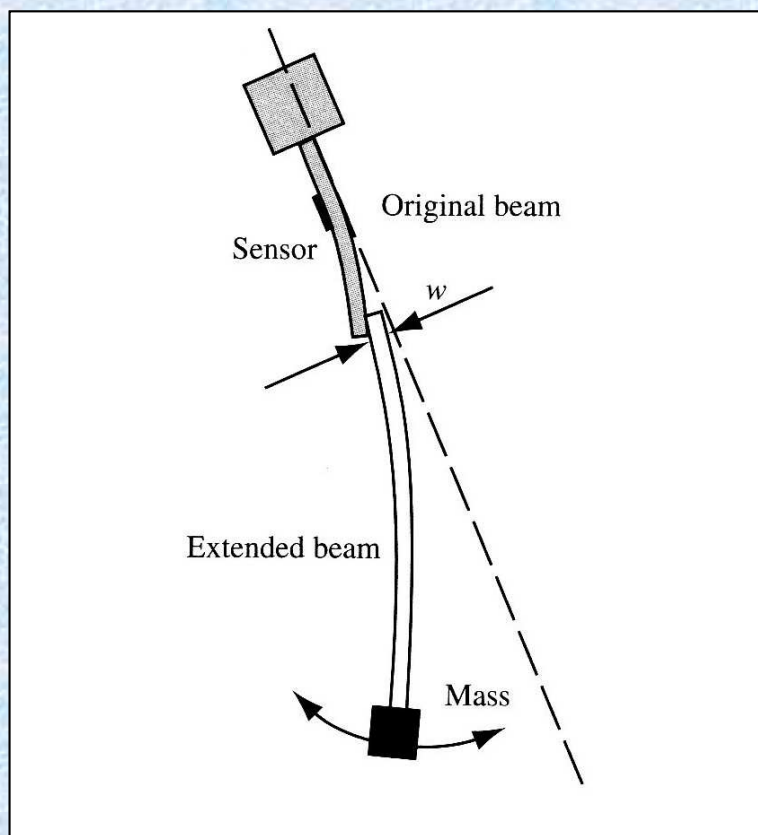
Principio de operación en modo pulso diferencial

-
-
-
-
-
-
-
-

-
-
-

SAW

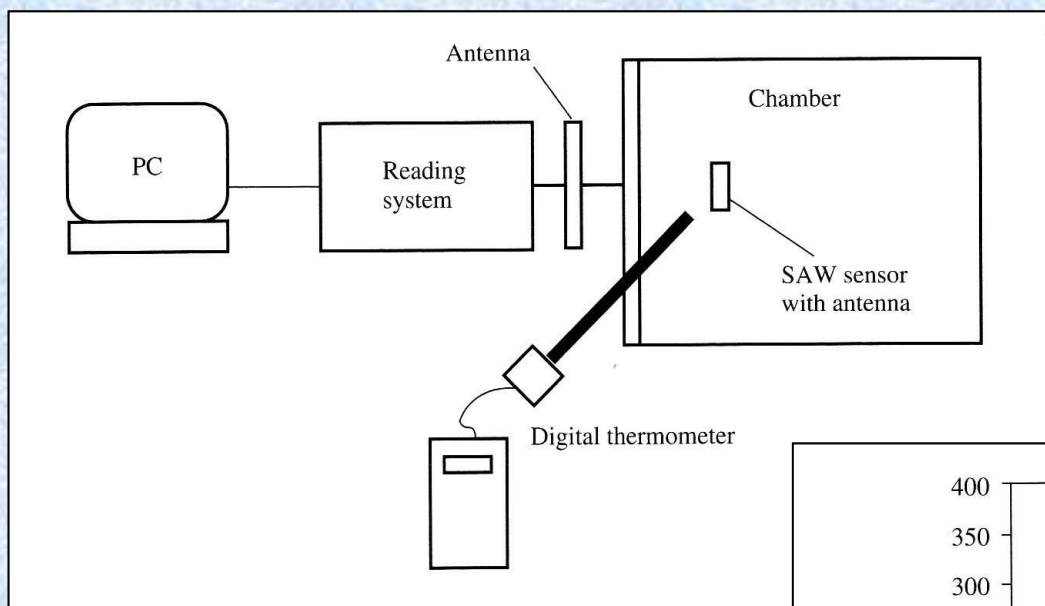
Sensor de esfuerzos y de presión



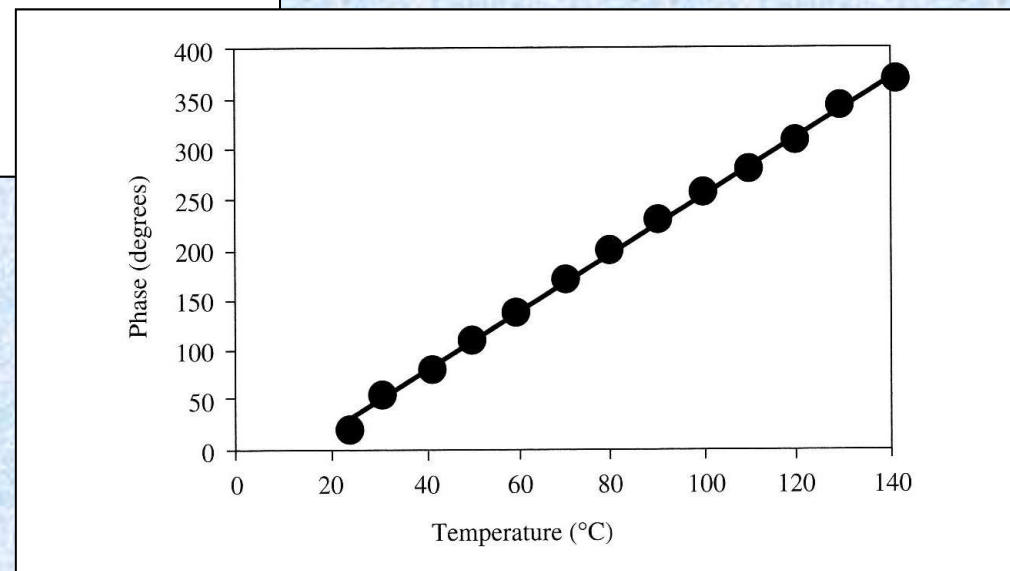
-
-
-
-
-
-
-
-

-
-
-

SAW



Sensor
de
Temperatura

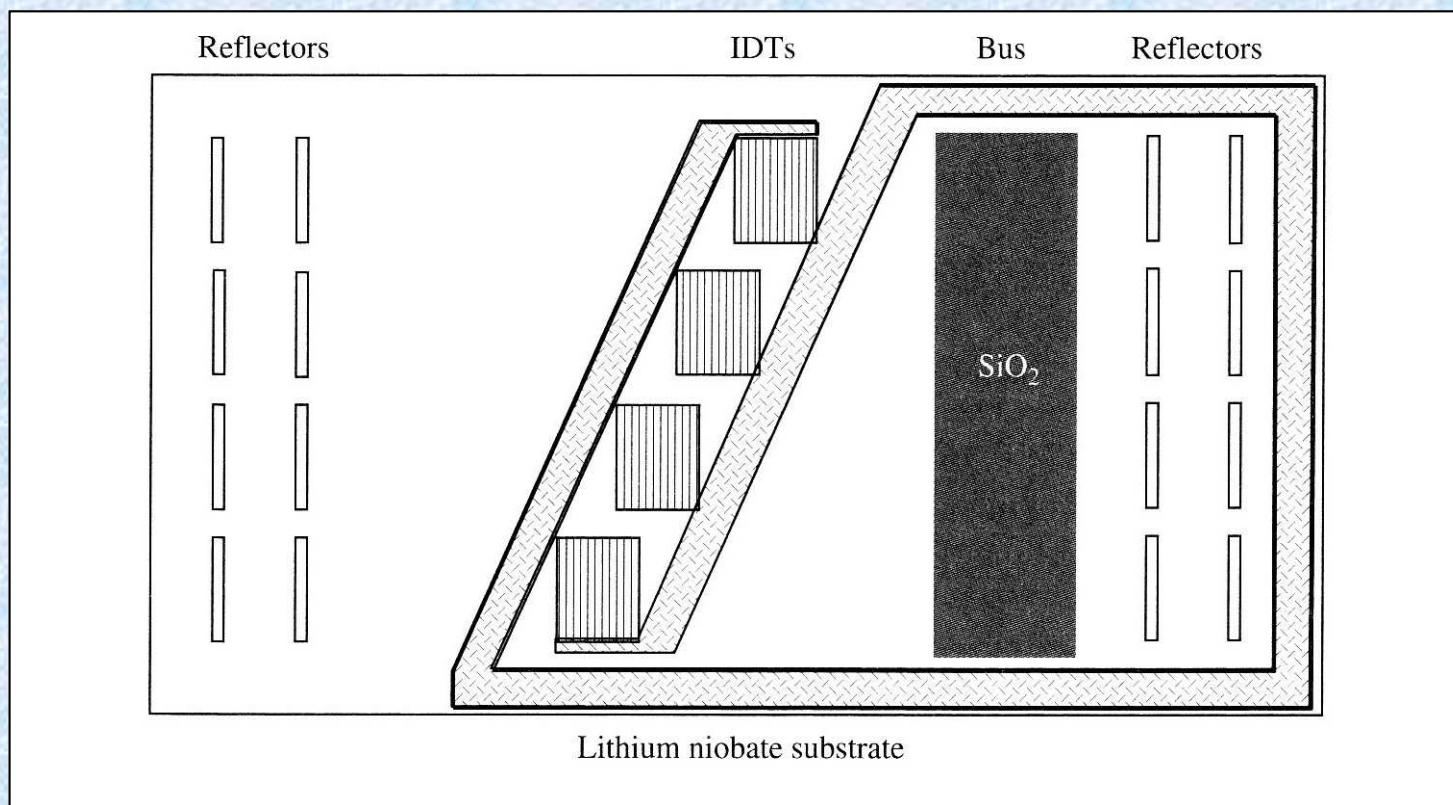


-
-
-
-
-
-
-
-

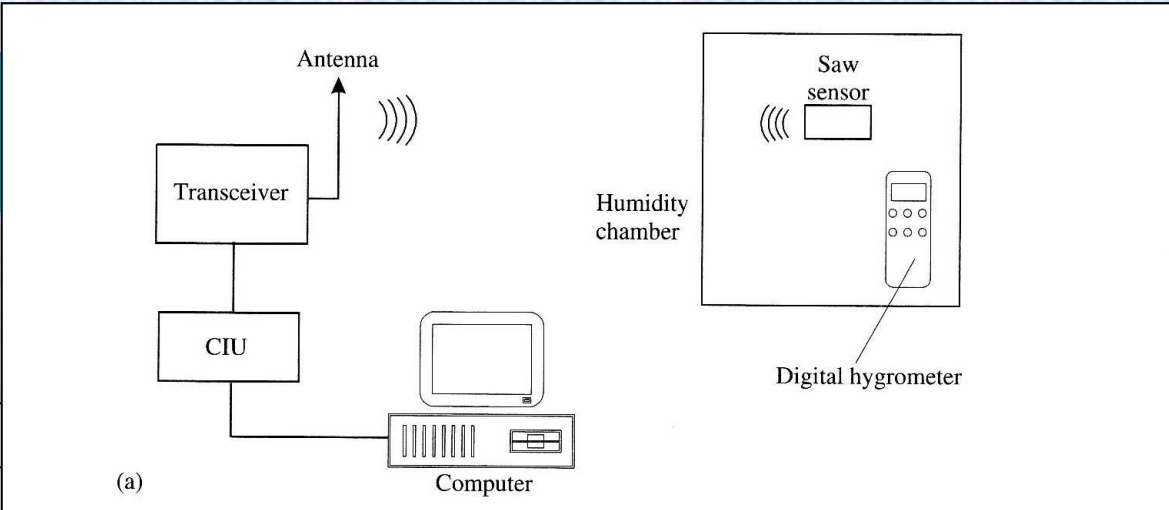
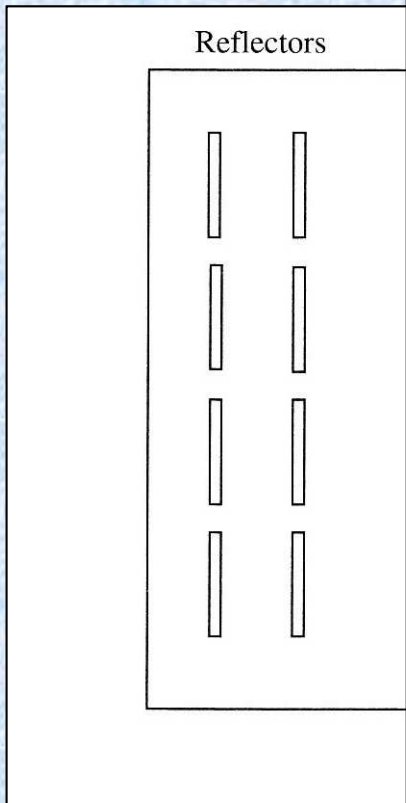
-
-
-

SAW

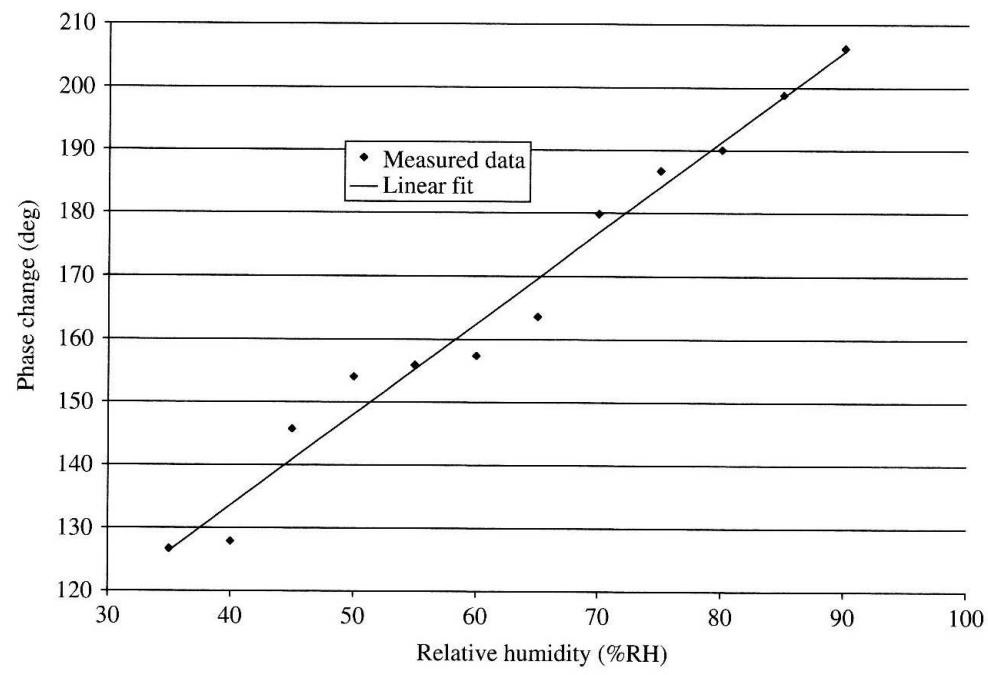
Sensor de humedad



-
-
-



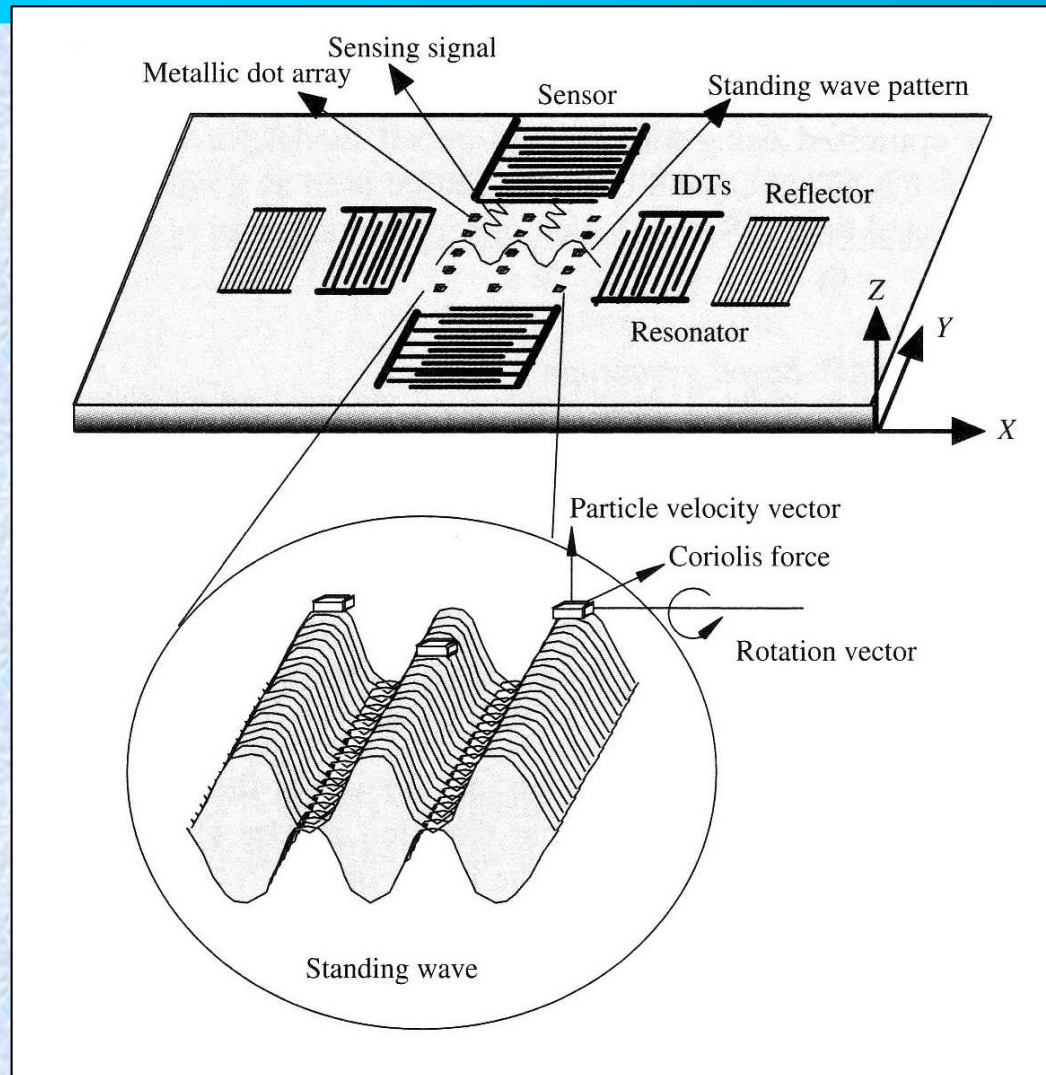
(a)



(b)

-
-
-
-
-
-
-
-

SAW

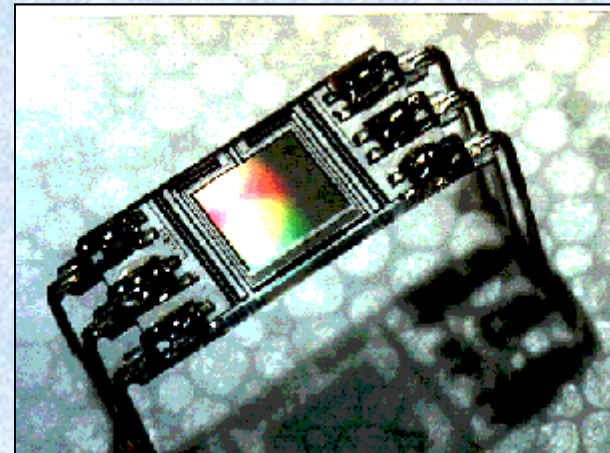
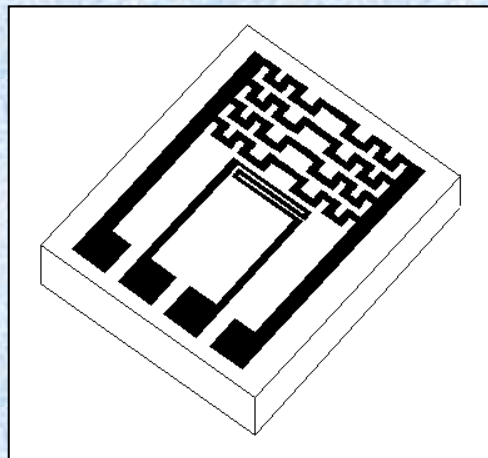
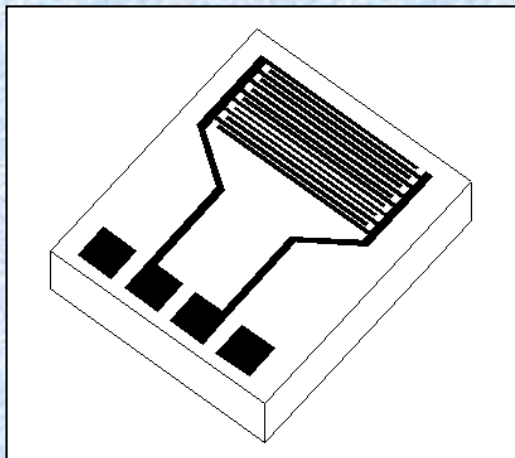
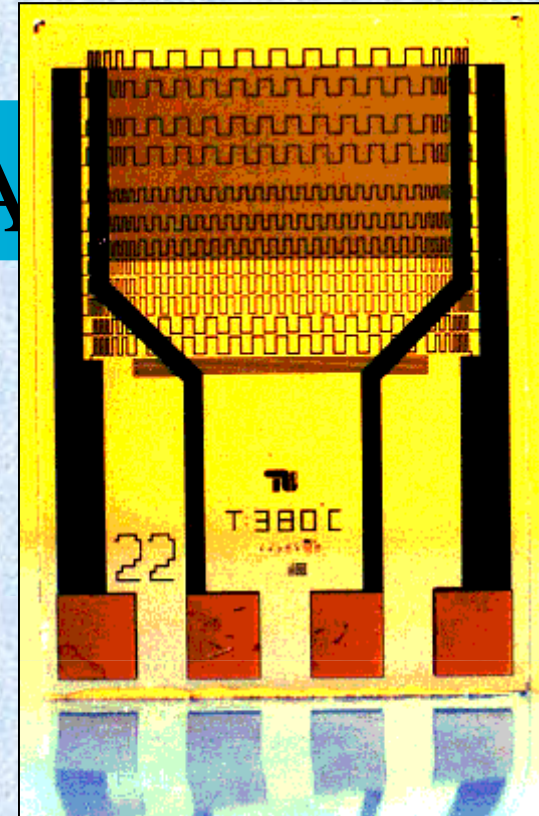
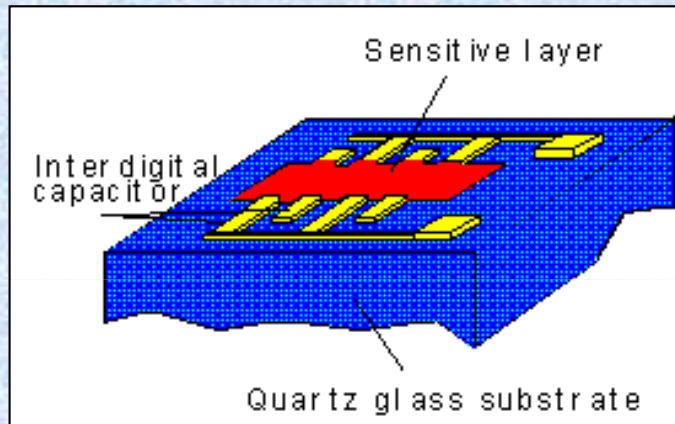


Giróscopo

-
-
-

Ejemplos: Sensores SA

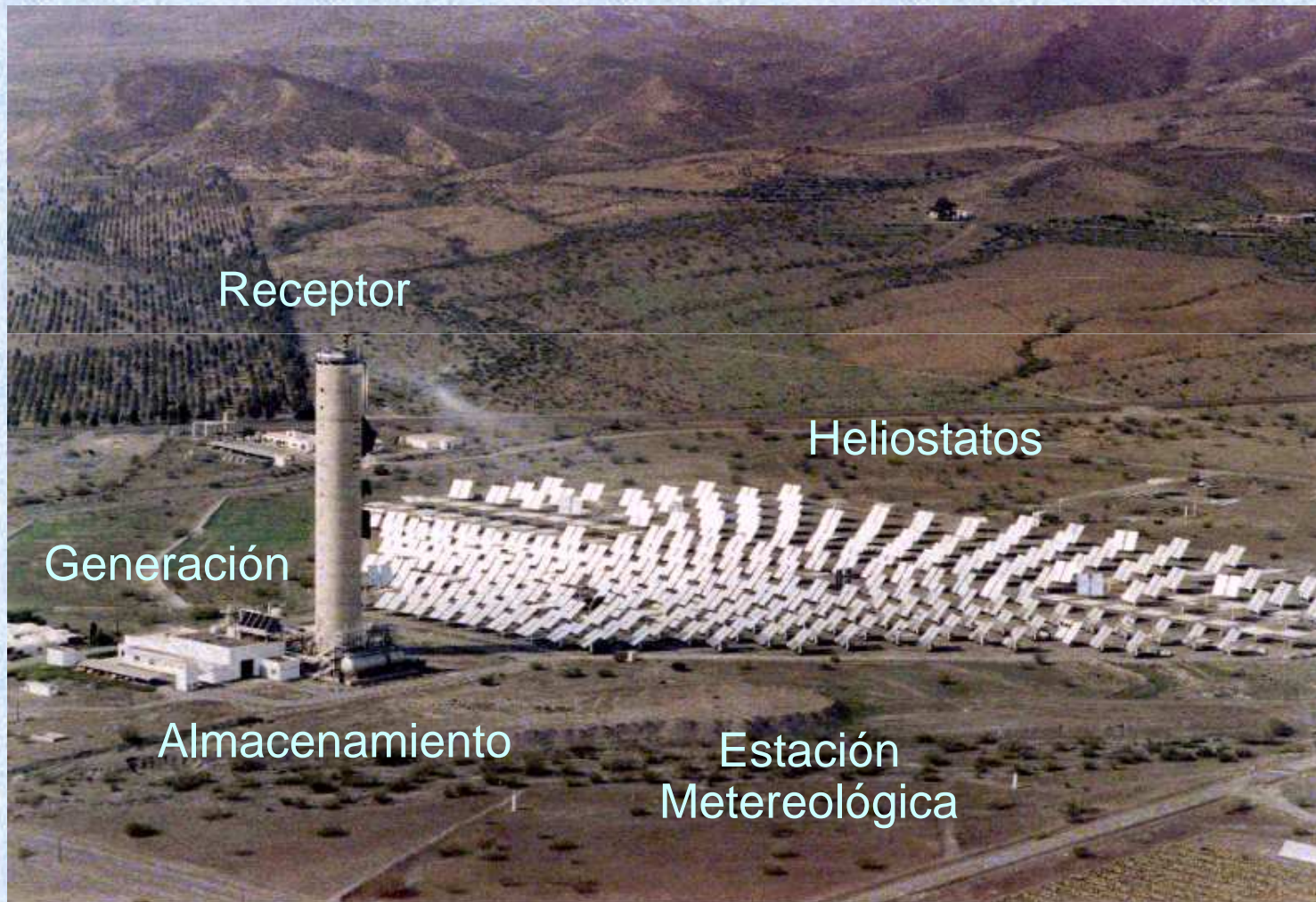
Sensores quimicos



-
-
-
-
-
-
-
-

-
-
-

Ejemplos: SENSOSOL



-
-
-

SENSOSOL

Descripción de un Heliostato

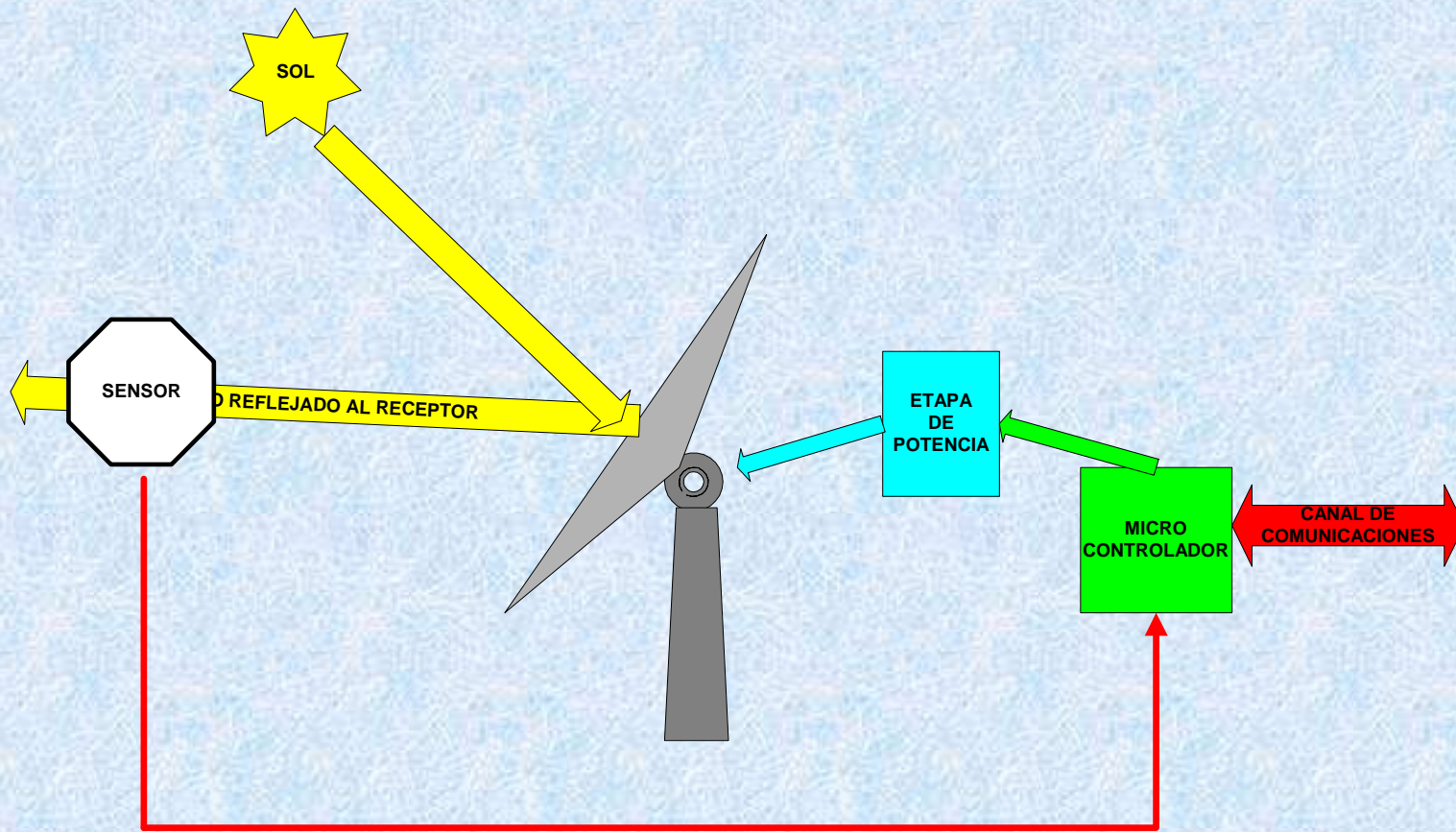


Control de orientación
de un espejo
en azimut y elevación

-
-
-

SENSOSOL

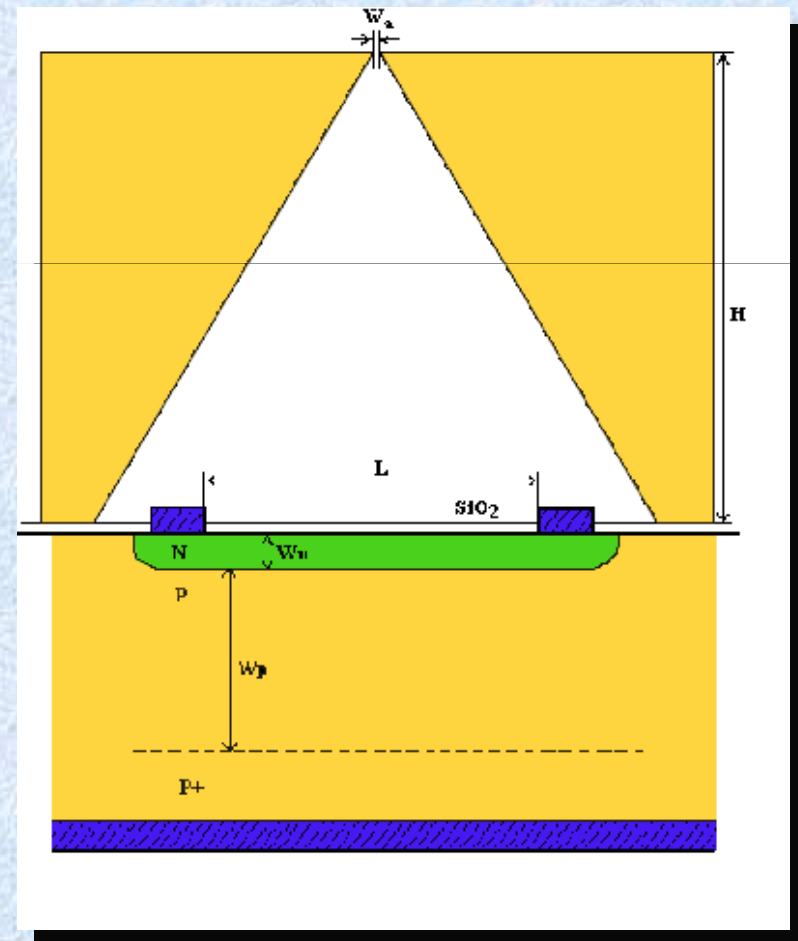
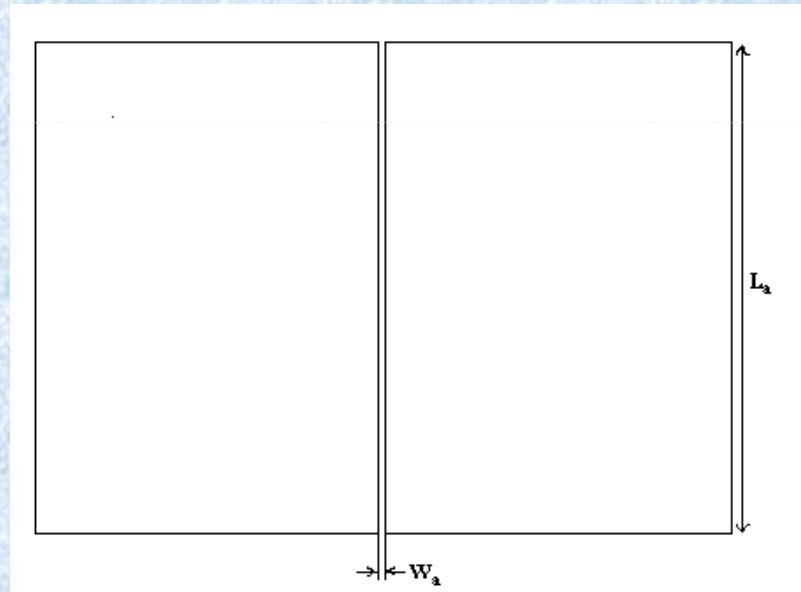
Esquema de Control en Bucle Cerrado



-
-
-

SENSOSOL

Estructura del Sensor

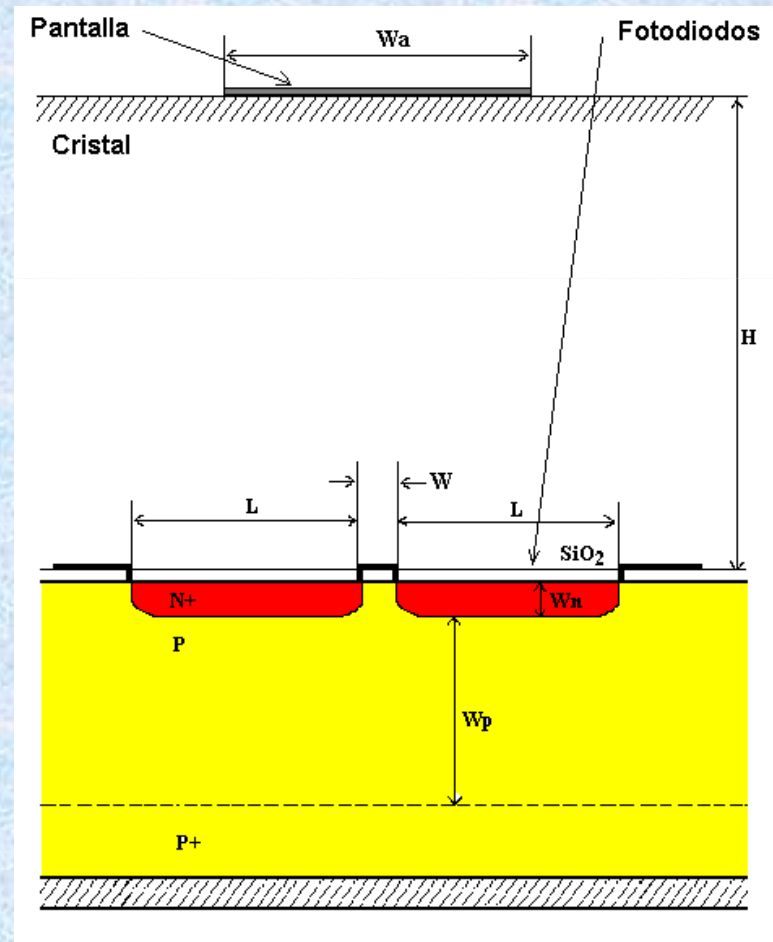
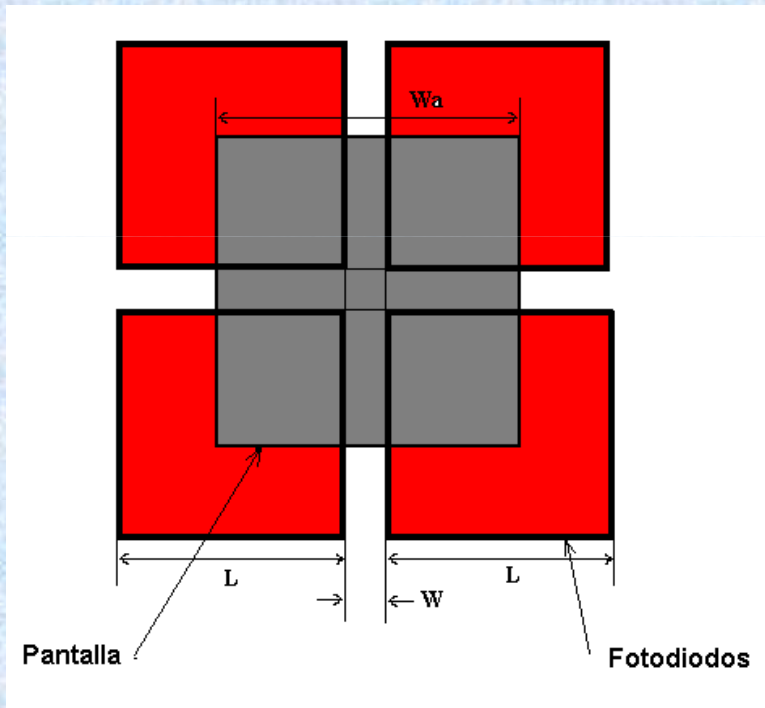


-
-
-
-
-
-
-

-
-
-

SENSOSOL

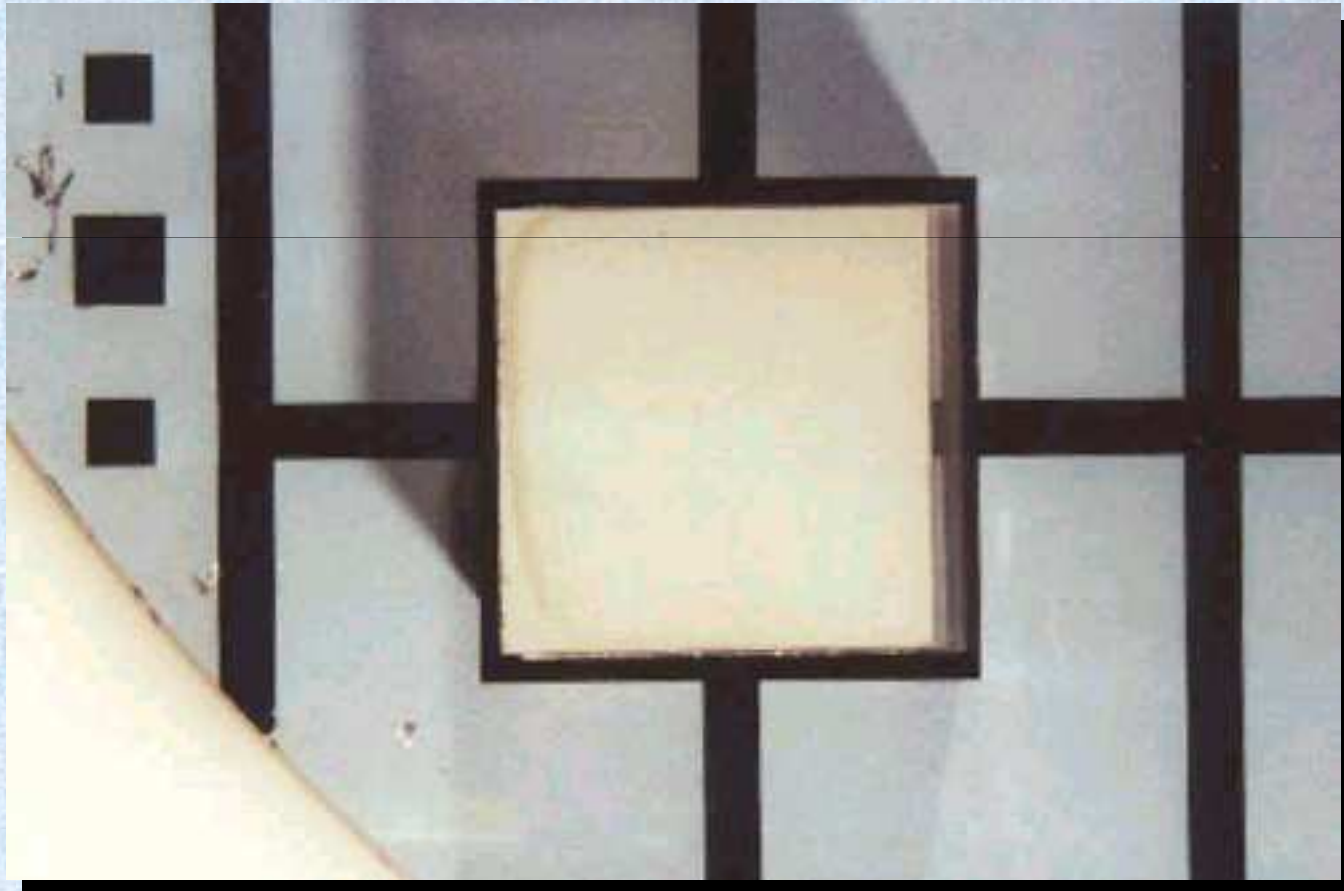
Esquema de Cuatro Cuadrantes



-
-
-

SENSOSOL

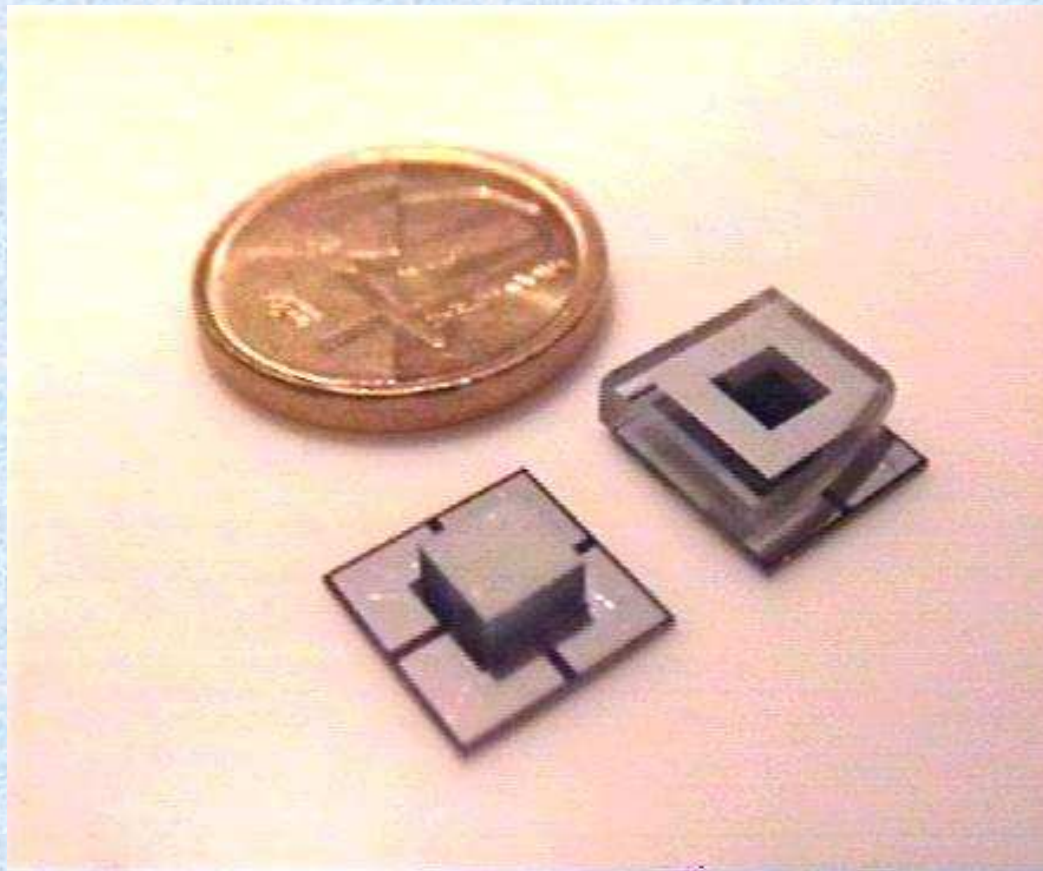
Dpto. Ingeniería Electrónica. UPC



-
-
-

SENSOSOL

Dpto. Ingeniería Electrónica. UPC



-
-
-

SENSOSOL

Aplicación a Paneles Fotovoltáicos

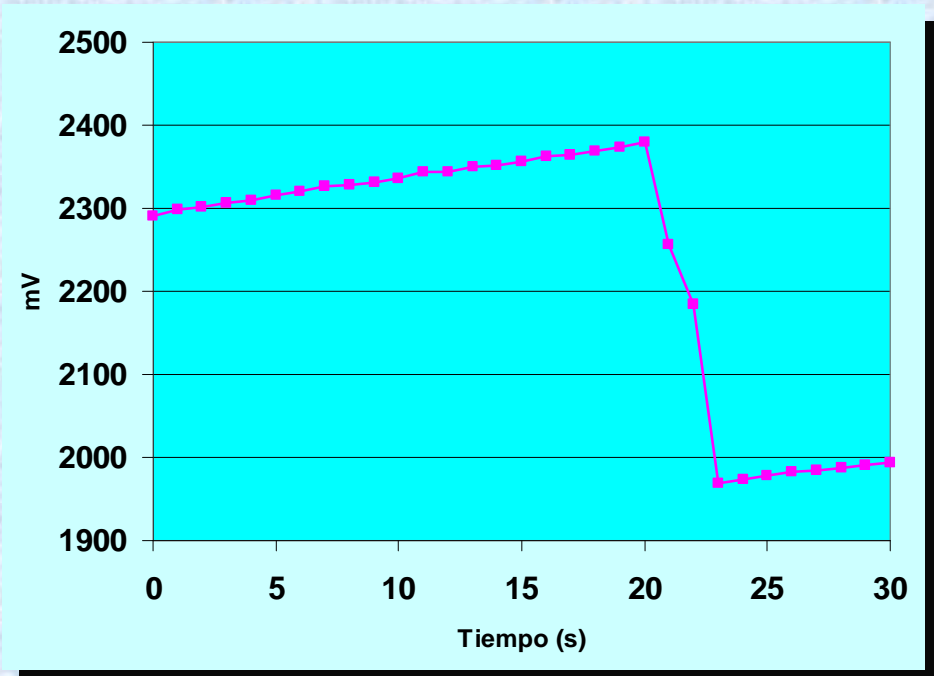
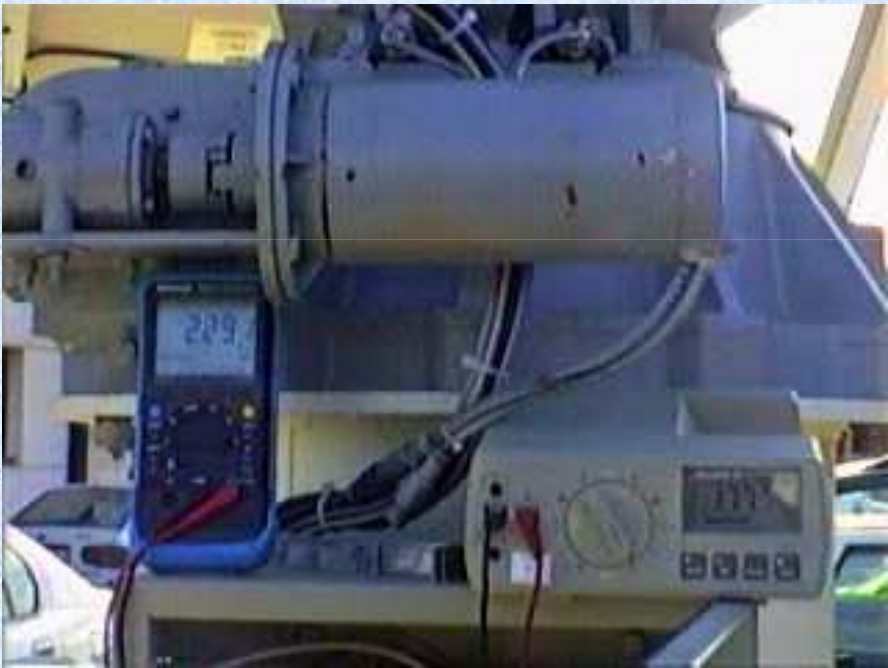


-
-
-
-
-
-
-
-

-
-
-

SENSOSOL

Aplicación a Paneles Fotovoltáicos



89mV en 20s → 4bits/mrad

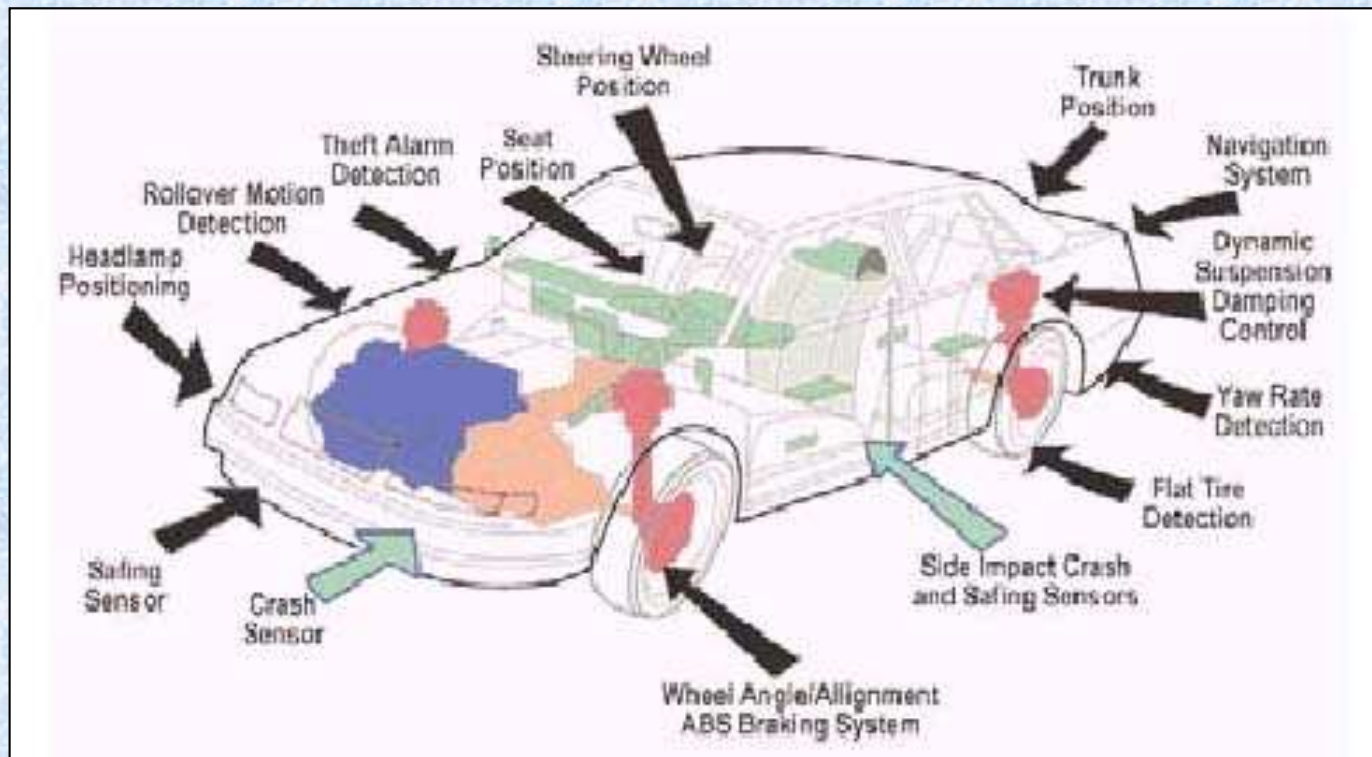


-
-
-
-
-
-
-
-

-
-
-

Industria Automovilística

Sensores de presión, movimiento, presencia....



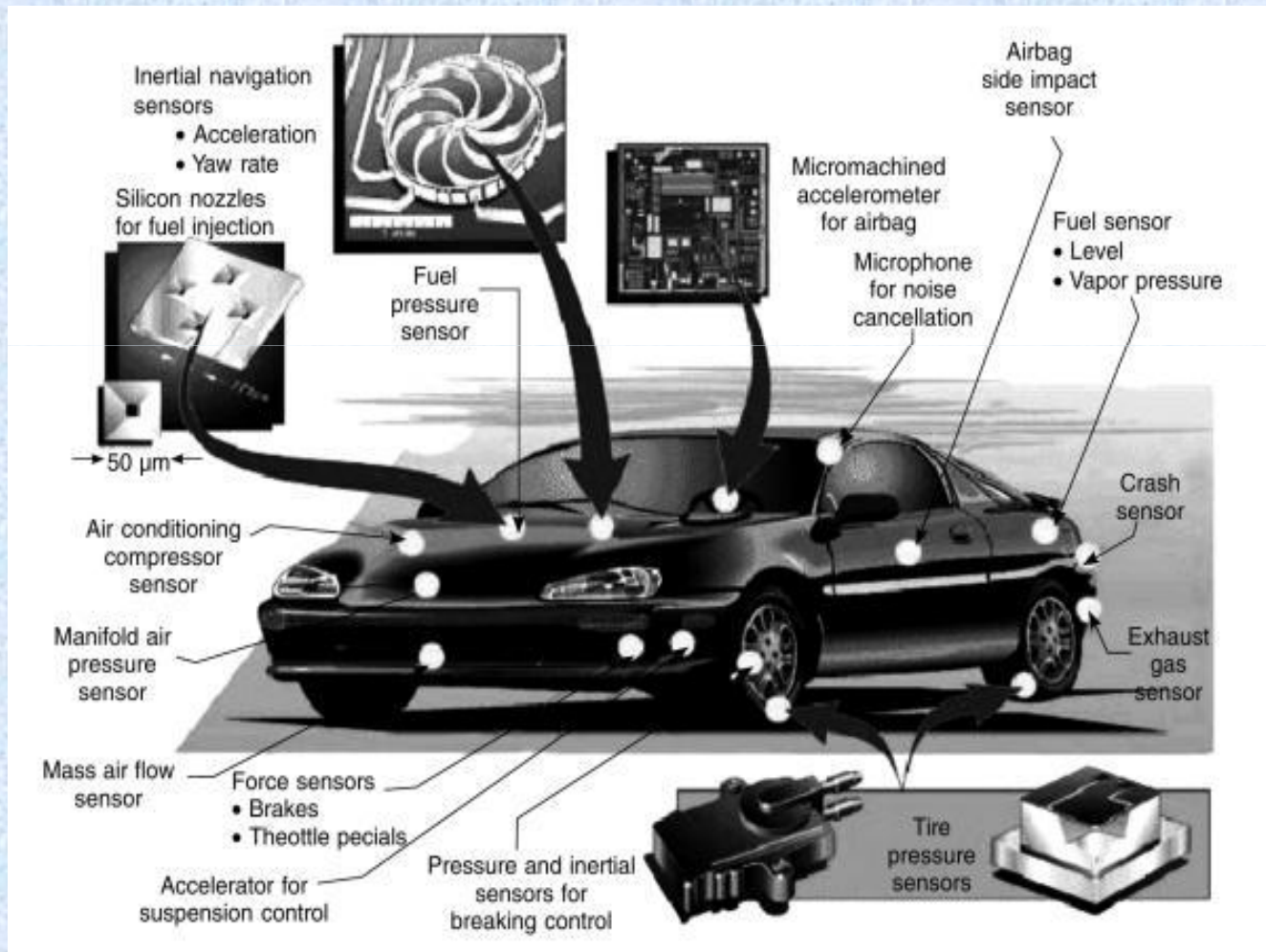
-
-
-

Industria Automovilística

- 1979 -Primer uso de MEMS en automóviles
- Norma federal de EEUU exigió medir la relación aire-combustible de los motores.
- Desarrollo de sensores capaces de medirla
- Sensores MAP (manifold absolute pressure) y MAT (manifold air temperature) usando MEMS
- Los MEMS basados en silicio dominaron el mercado durante las décadas siguientes
- Primeros desarrollos: Delco Electronics/GM (piezorresistivos), Ford Motor (capacitivos)

-
-
-










Sensores en un coche



Sensores en un coche


BOSCH MEMS Sensors

Bosch MEMS Sensors for Automotive Applications

Inertial Sensors	Gyroscope (Airbag, Navigation) 	Accelerometers (Airbag, ESP) 	Yaw rate sensors (for ESP systems) 
Pressure Sensors	MAP (Motronic) 	High Pressure (Motronic) 	BAP (Motronic, Airbag) 
Media + Weight Sensors	i-Bolt (Seat occupancy) 	CO ₂ , NO, T, H ₂ O 	Oil Condition 

2004: > 95 Mio Sensors

Chassis Systems

 **BOSCH**

CS-SNS/SPS / ECS4-Aachen | 01/08/2005 | © Robert Bosch GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties.

-
-
-

Sistemas de estabilidad

BOSCH Inertial Sensors

Roadmap Inertial Sensors for ESP Application

steel macro mechanic

silicon bulk / surface micromachining

surface micro machining

1995 **2000** **2005**

Chassis Systems

5 CE-SNS/EP5-Basis / ECS4-Axten | 01/05/2005 | © Robert Bosch GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties.

-
-
-
-
-
-
-
-

-
-
-

Sistemas de estabilidad

BOSCH MEMS Sensor Cluster DRS-MM3.x

Sensor Cluster DRS-MM3.x

- Modular concept for flexible configuration of angular rate and acceleration sensor elements
- Excellent vibration robustness (5g sinus 0...10kHz)
- High robustness due to digital internal signal processing and communication
- Multi-level safety monitoring concept



Chassis Systems



BOSCH

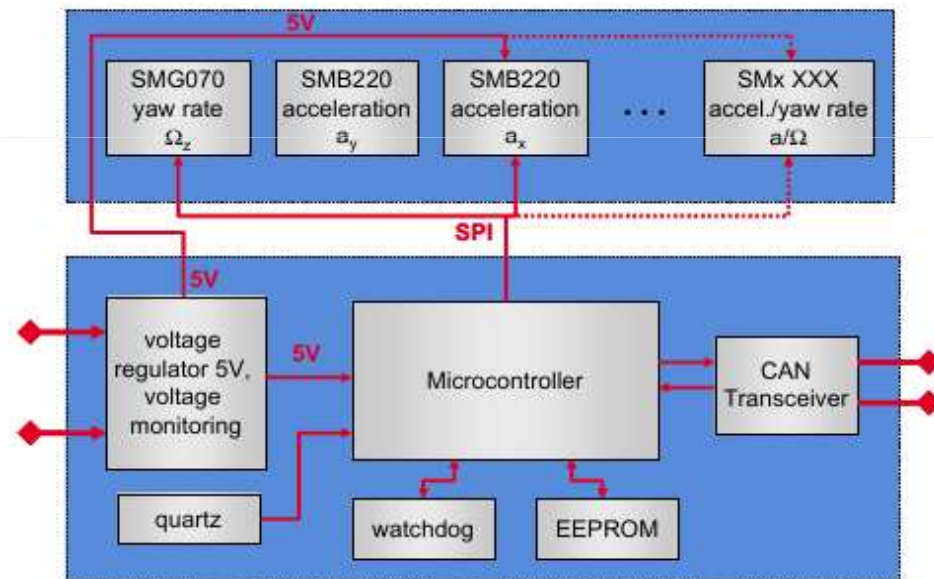
-
-
-
-
-
-
-
-

-
-
-

Sistemas de estabilidad

BOSCH MEMS Sensor Cluster DRS-MM3.x

Block Schematic Sensor Cluster DRS-MM3.x



Chassis Systems

10

CS-SNS/PG-M | 01/08/2005 | © Robert Bosch GmbH reserves all rights even in the event of industrial property rights. We reserve all rights of disposal such as copying and passing on to third parties.



BOSCH

-
-
-
-
-
-
-
-

Sistemas de estabilidad

BOSCH MEMS Inertial Sensors

MEMS Inertial Sensors SMB220 / SMG070

- Individually packaged sensor elements suitable for integration into system ECU
- Internal parametric monitoring of measuring element and ASIC
- High resolution
- High accuracy, low noise



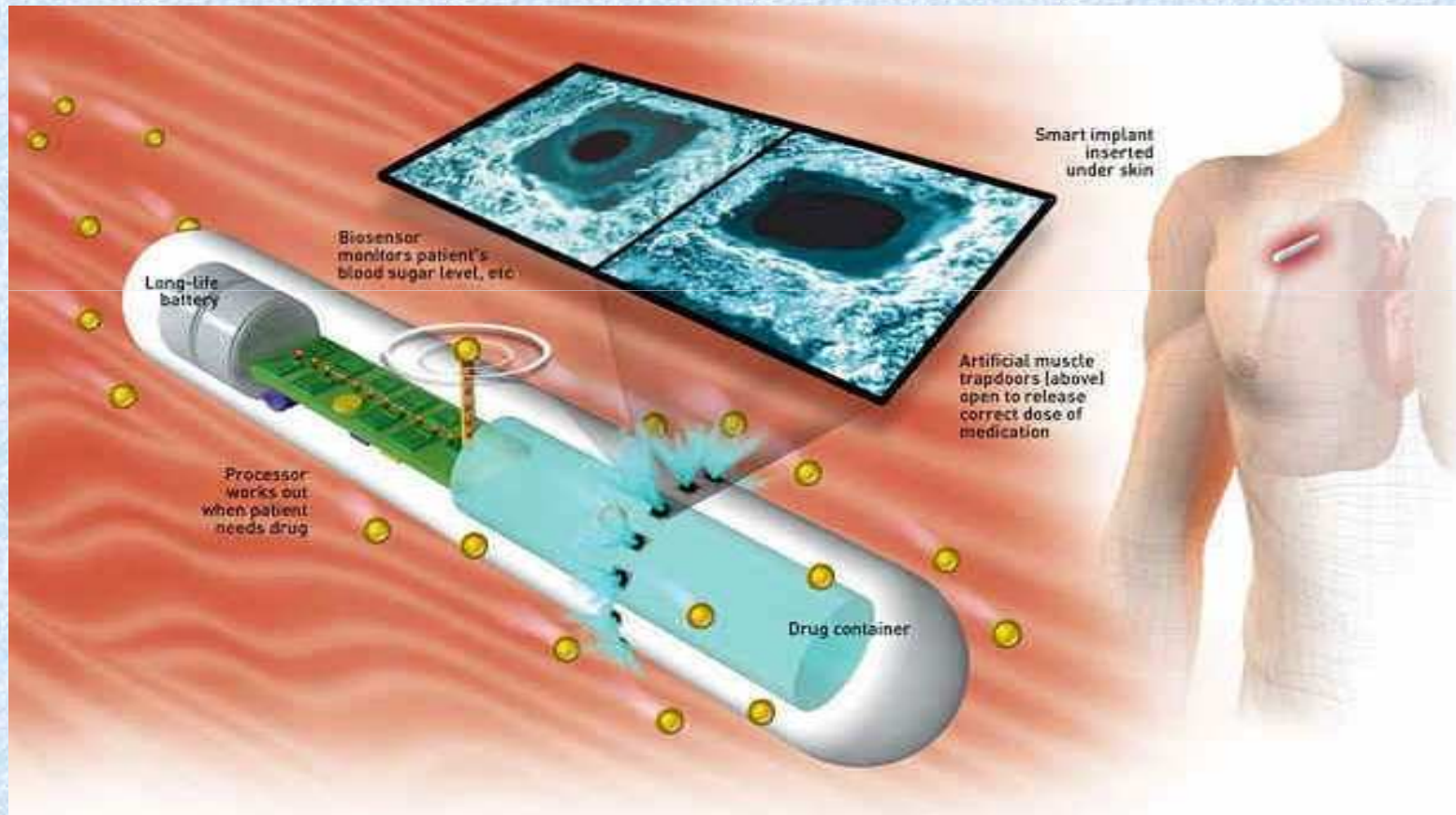
	Angular velocity output (SMG070)	Acceleration output (SMB220)
Measuring range	+/- 187 °/s	+/- 4.9 g
Nominal sensitivity	175 LSB/ °/s	6667 LSB/g
Quantization	16 bit	16 bit
Non-linearity	+/- 0.5 %	+/- 1.0 %
Sensitivity error	+/- 2.5 %	+/- 2.5 %
Cut-off frequency (-3dB)	60 Hz	60 Hz
Signal noise	0.05 °/s rms	0.004 g rms
Offset error	+/- 1.5 °/s	+/- 0.05 g
Cross axis sensitivity	+/- 2.0 %	+/- 2.5 %
g-sensitivity	+/- 0.3 °/s/g	

Chassis Systems



-
-
-

Smart pill



-
-
-
-
-
-
-
-