ACTIVE IMPLANTS

Glass Encapsulation

VALTRONIC™ Because Experience Matters

OUTLINE

- Smart Implants Overview
- Cylindrical Glass Encapsulation CGE
- Planar Glass Encapsulation PGE
- Platform for Innovative Implantable Devices

ACTIVE IMPLANTS OVEVIEW

SMART IMPLANTS

What Do We Mean By Smart?

An implant that is able to provide in-vivo diagnostic biofeedback and/or treat a patient according to specific conditions

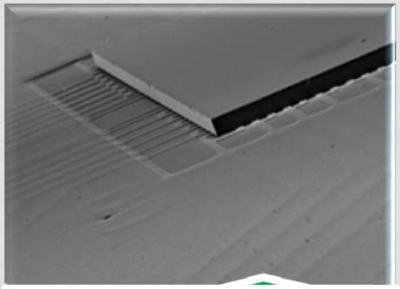
- Microsystem measuring and transmitting diagnostic data during or after implantation
- Needs to function in an autonomous way during the lifespan of a product which varies from 6 months to over 50 years

ACTIVE IMPLANTS INDUSTRY TRENDS

- Increased safety of patient: resistant, long term stable, biocompatible
- Longer autonomy: ultra-low power electronic, transfer and storage
- Patient “on-line” information:
  - Data computing and front-end data treatment
  - Accessible real time data (mobile applications)
- Minimally invasive:
  - Miniaturization, functionalization of encapsulation
- More interaction with biological elements:
  - More accurate measurement and stimulation

SMART IMPLANT CHALLENGES

Packaging / encapsulation



Reliable Processes & Technology

Powering & Autonomy

Detection & Sensing

Memory

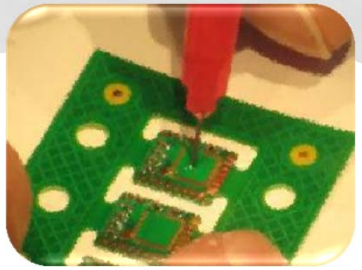
Interaction

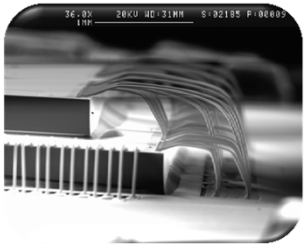
&

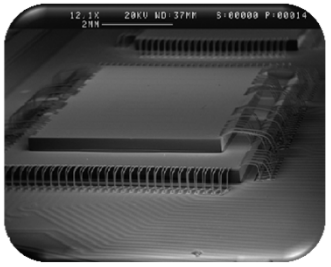
Communication

MINIATURIZATION TECHNOLOGIES

- Substrate design with specific metallization
- Die attach with specific materials
- COB with fine Al wire
- Chip on Chip
- Ultra fine pitch Wire Bonding
- Ultra Sonic Flip Chip
- High Precision SMT
- 3DCSP

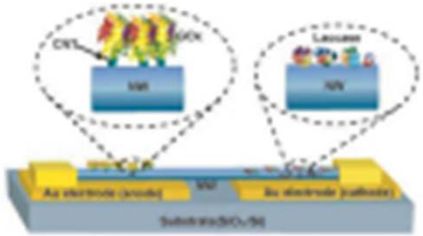


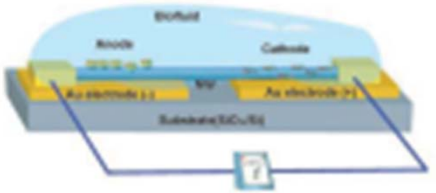




POWERING CONCEPTS

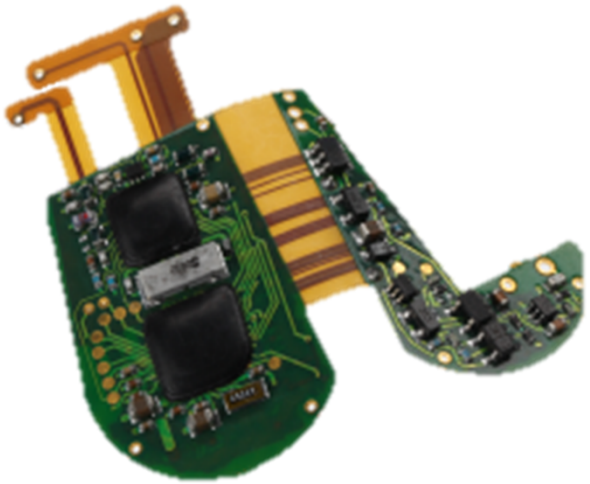
- External RF link
  - Non self powered implant
  - Compatible with reduced dimensions
- Rechargeable Battery
  - Size non-compatible with highly integrated device
  - External device is needed for the patient
- Permanent Battery
  - Non-compatible with highly integrated device
  - Battery needs to be replaced after a defined period
- «Harvesting» Energy
- Concepts Bio-Fuel



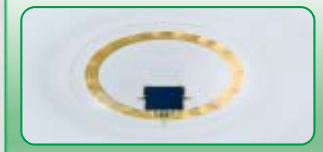


COMMUNICATION & MEMORY

- External link
- Bi-Directional link
- Continuous Monitoring (100%/24/7)
- Duty cycling of measurements and data creation
- Power storage



ENCAPSULATION APPLICATION CLASSIFICATION



Short term human contact (24-48 hr)
Silicone encapsulation

Medium term human contact (30 days – 6 month)
Epoxy / multilayer encapsulation:

Long term implantation (1 – 5 – 10 Years)
Titanium housing

Long term implantation (1 – 5 – 10 Years)
Glass encapsulation (cylindrical or planar)

CYLINDRICAL GLASS ENCAPSULATION (CGE)

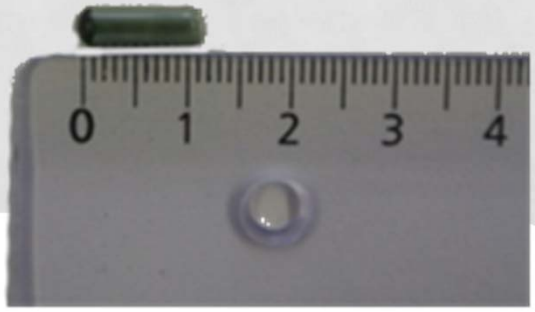
LASER WELDING PROVEN PROCESS

Process Development

- CGE Development Equipment
- All Main Process Functions Integrated
- Own Process Software
- Automated Processing
- Dedicated Formulations

Low temperature process!
Preserves integrity of embedded elements

TOP LEVEL SPECIFICATIONS



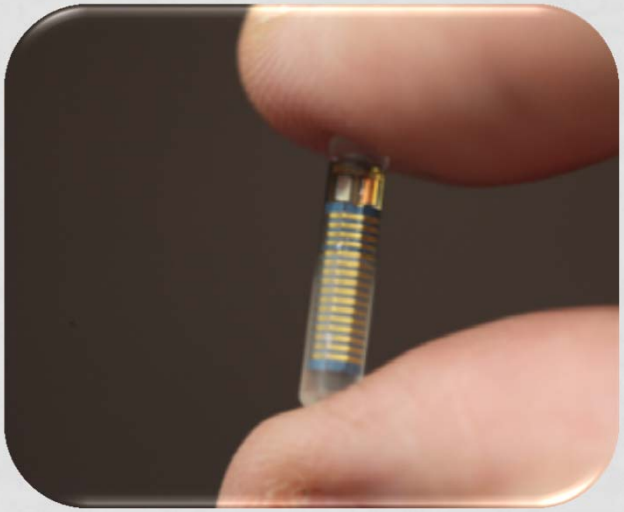
- CGE Capability Today
  - Glass Types: Boroscilicates, AR, KOVAR, Quartz, Bioglass
  - D_{out}: 4/6/8 mm [2…12mm<4 weeks]
  - Wall Thickness: 0.4 – 0.6 mm [other< 4 weeks]
  - Length: 12…50 mm [<12: on request]

- CGE Bio-compatibility
  - According to ISO 10993-1
  - CGE Tightness >10 years

(electronics protected against breakdown by moisture proved by tritium tests completed)

APPLICATION: INJECTABLE GLUCOSE MEASUREMENT SYSTEM

The miniaturized sensor is designed to measure glucose in the interstitial fluid



PLANAR GLASS ENCAPSULATION (PGE)

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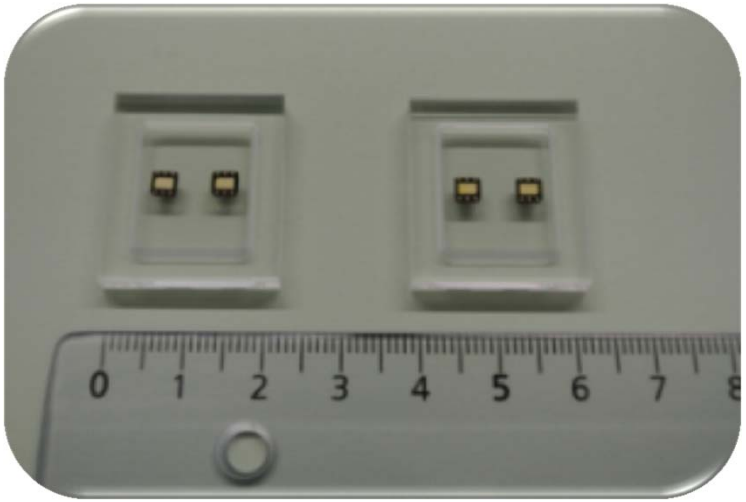
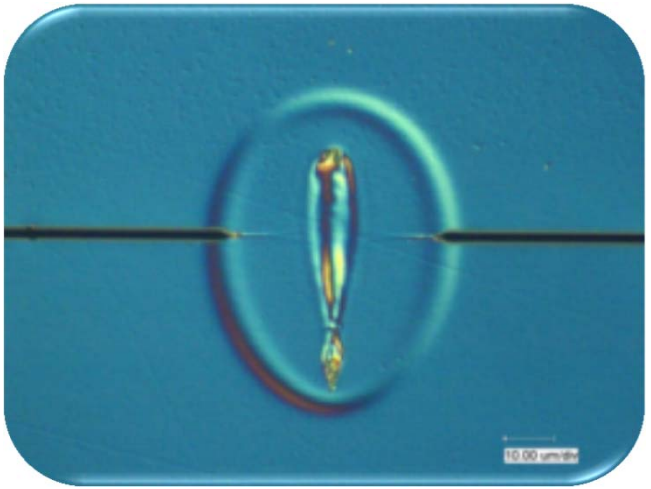
- Glass encapsulant itself may perform a function other than simply encapsulation, such as actually monitoring pressures (blood or intracranial)
- PGE assembly process supports a high level of feature (leads) density in extremely small implants and has a high level of hermeticity

ASSEMBLY PROCESS

- Laser Glass – Glass Joining Process Parameter optimization
- First test of mechanical stability (seam)

(shear resistance/binding energies)

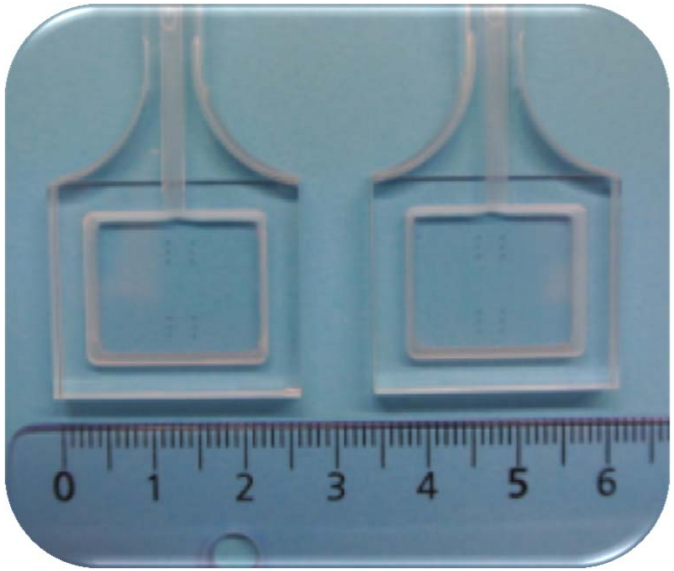




HERMETICITY

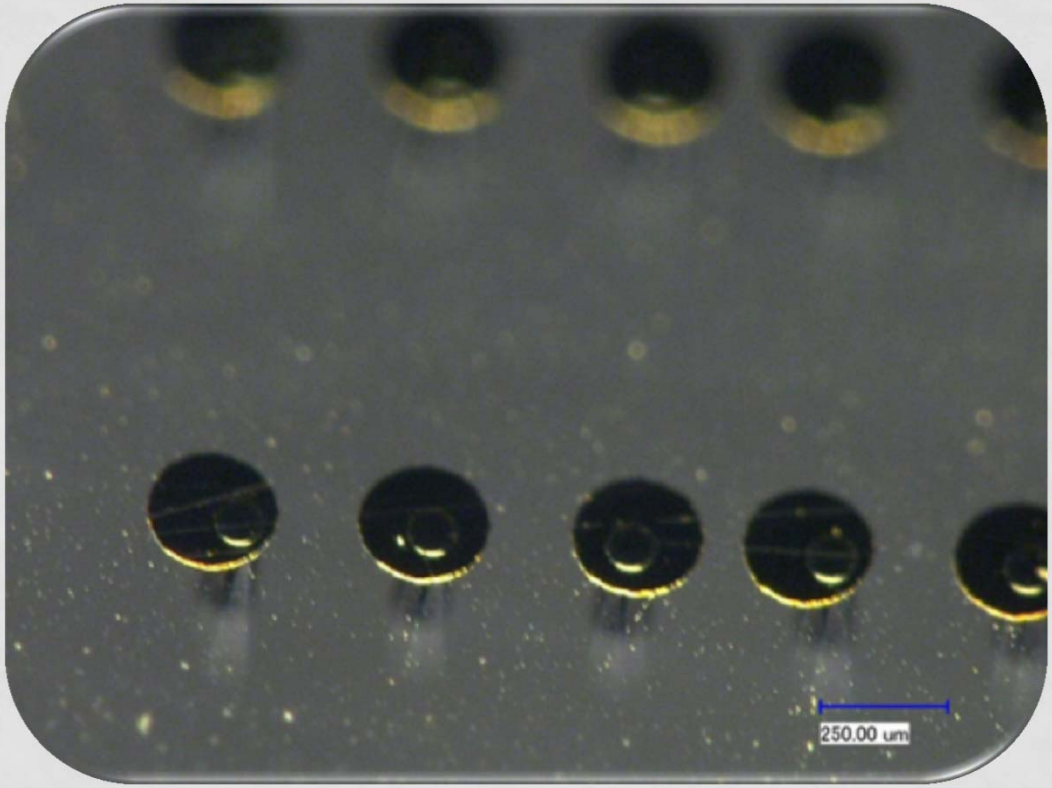
- Test Devices 2nd Generation
- Big cavities according to requirement of Valtronic with and without TGV for helium leakage test and tritium tightness tests.

Proven long term hermeticity!



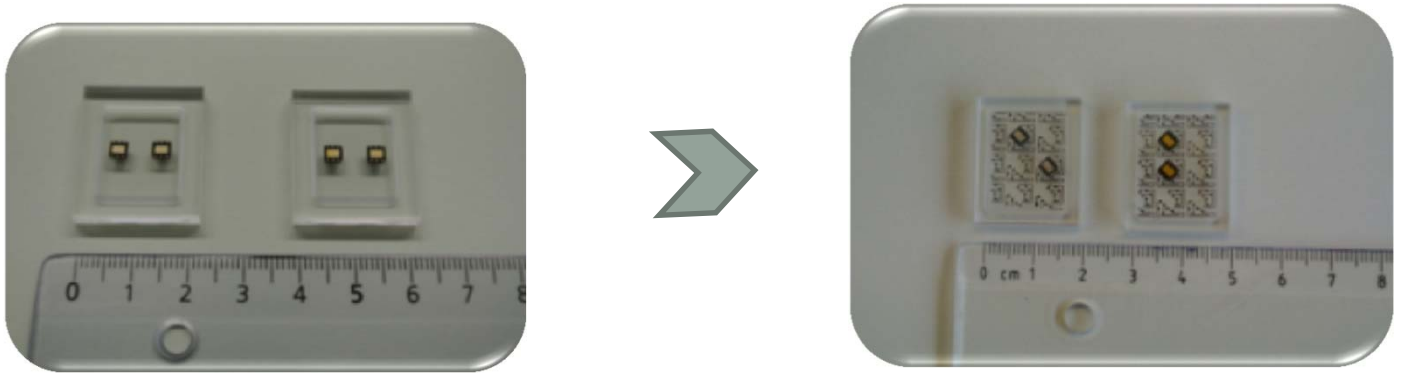
GOLD PLATING OF TUNGSTEN VIAS

Enable micro-assembly interconnection technologies!

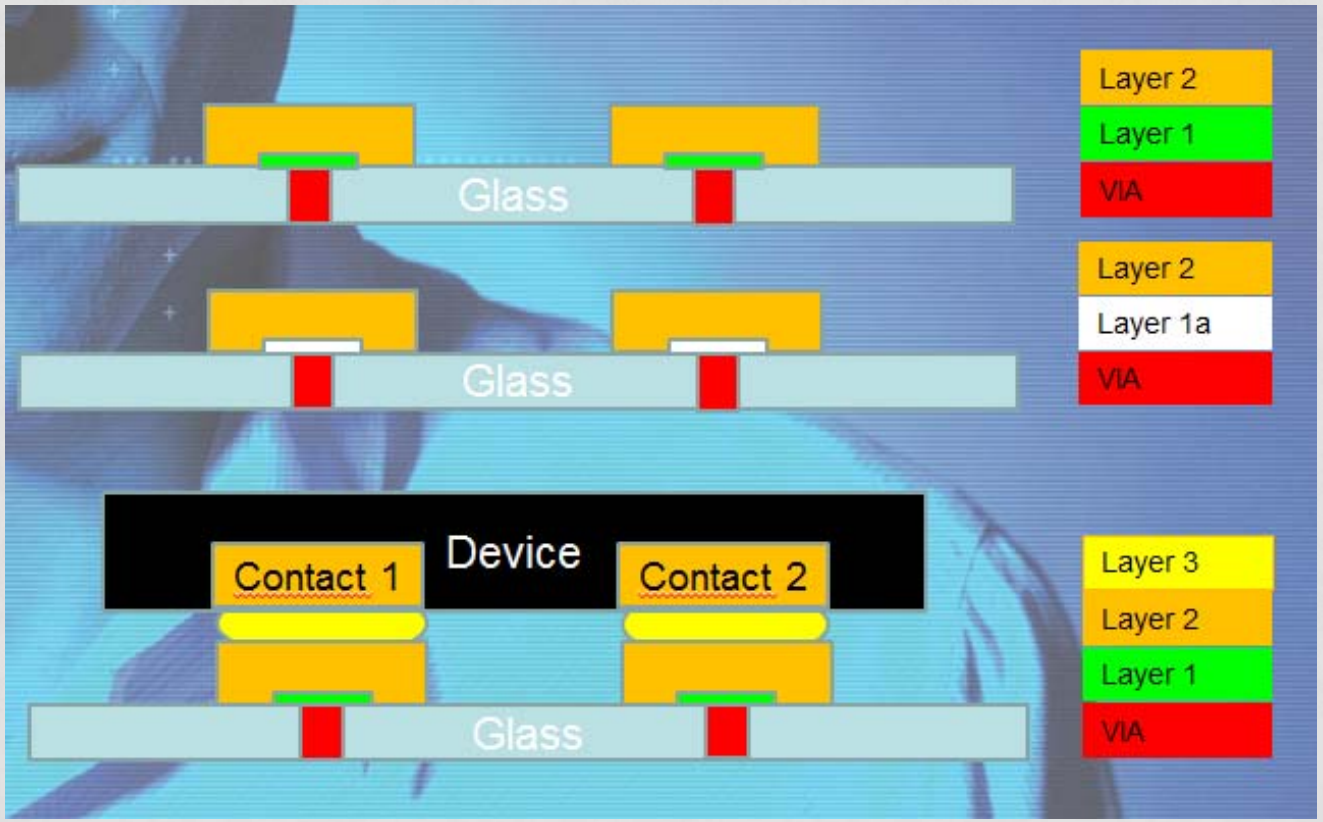


CONNECTIVITY AND HOUSING FUNCTION

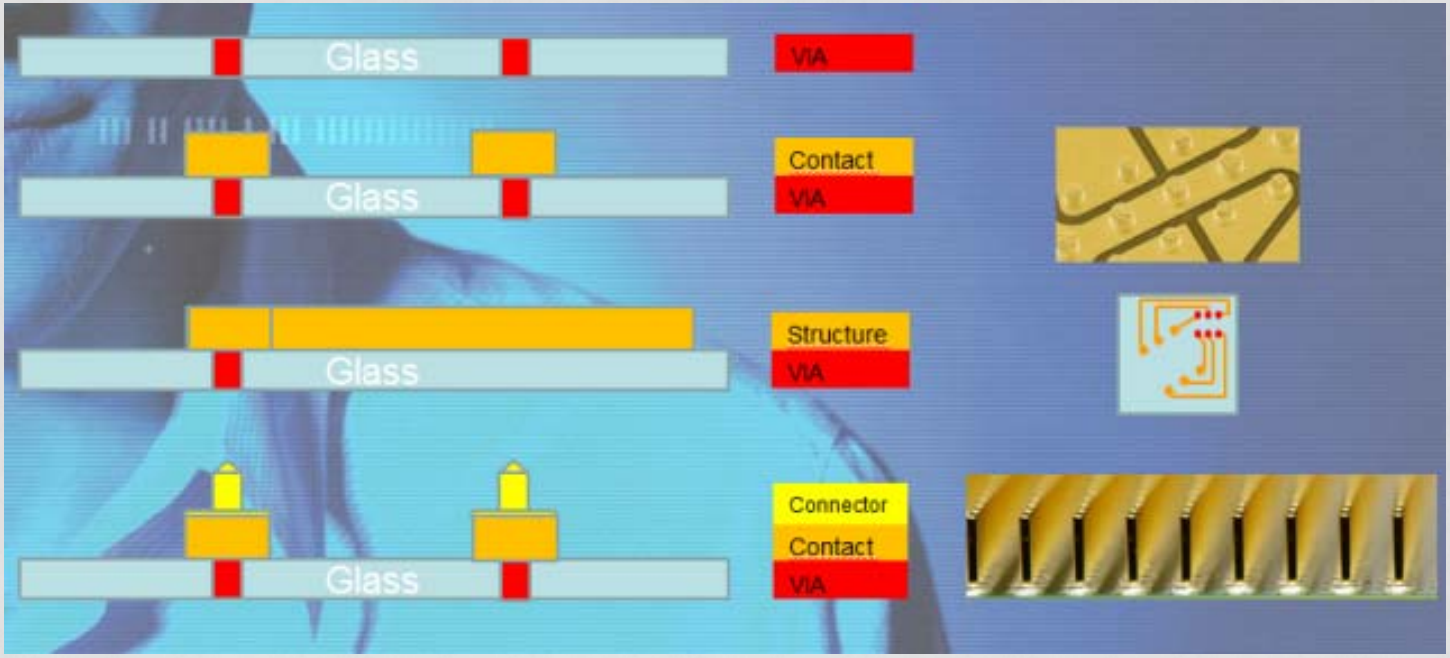
- Processing Contact Layer (Au) on Glass and Tungsten Vias as pads and as circuit paths
- Contacting Sensors direct on Tungsten Vias and direct on circuit paths



MICROSTRUCTURE INSIDE THE HERMETIC CAVITY

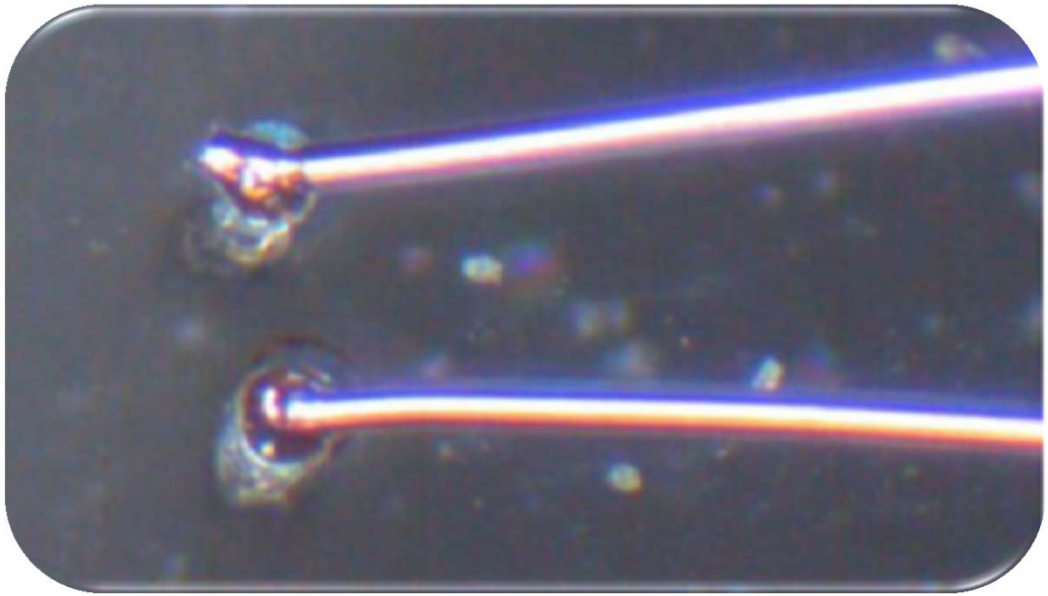


CONNECTING TO BIO
(HIGH DENSITY FEED-THROUGH)



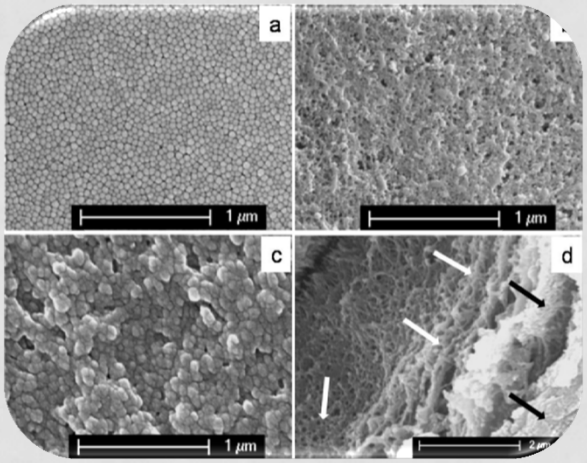
CONNECTING TO BIO AND LEADS

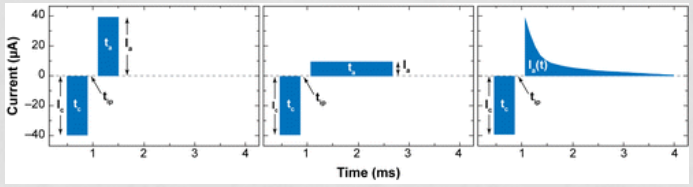
- First electrical contacting
- Direct contacting platinum-iridium on Tungsten Vias by laser

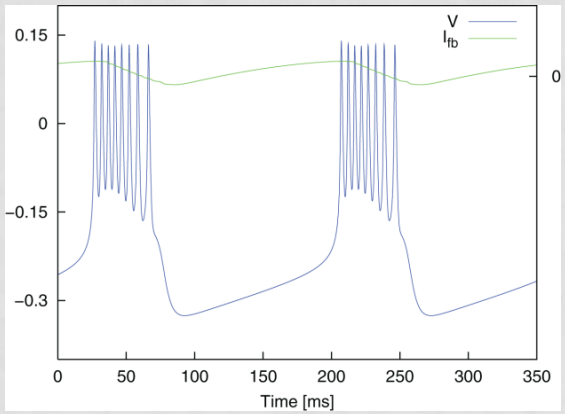


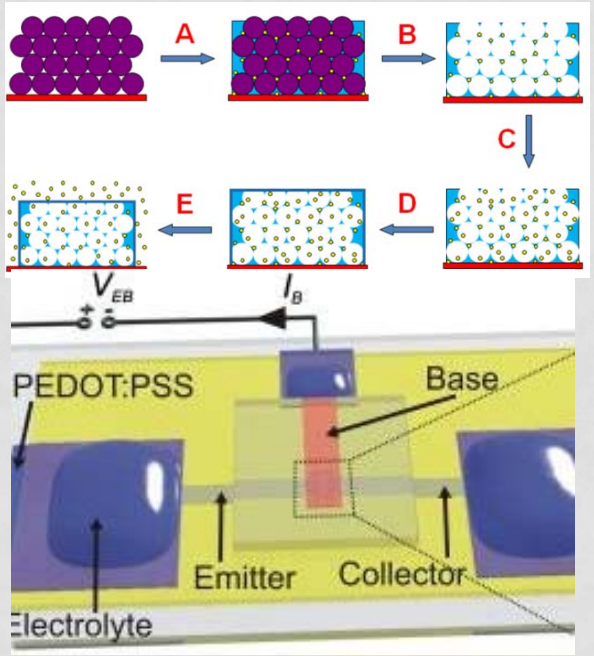
ELECTRODES AND LEADS

1. Classical Platinum versus
   TiNi / IrOx with surface enhancement
2. MEMS
3. Ion-FETs





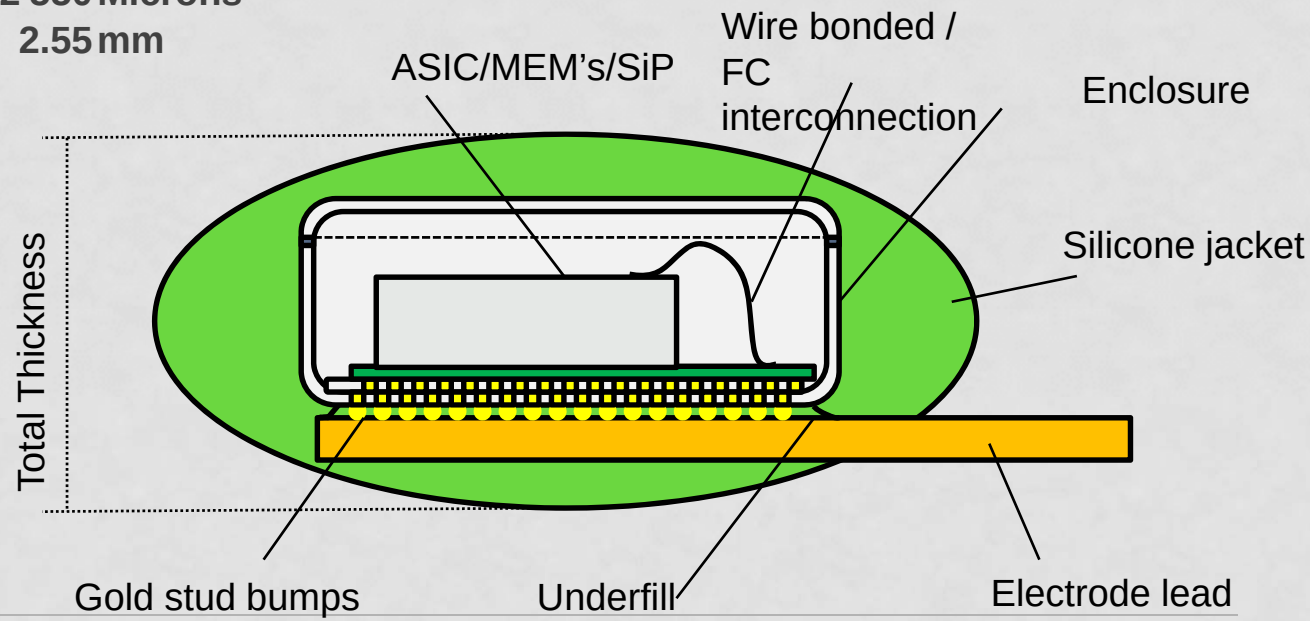




PLATFORM FOR INNOVATIVE IMPLANTABLE DEVICE

INNOVATIVE DESIGN APPROACH

Elements	**Microns**
Silicone jacket	600
Enclosure Top thikness	300
Cavity for electonic's	1'000
Enclosure Bottom thickness	300
FC Interconnect	50
Lead thickness	300
Total Thickness	**2'550 Microns**
	2.55 mm



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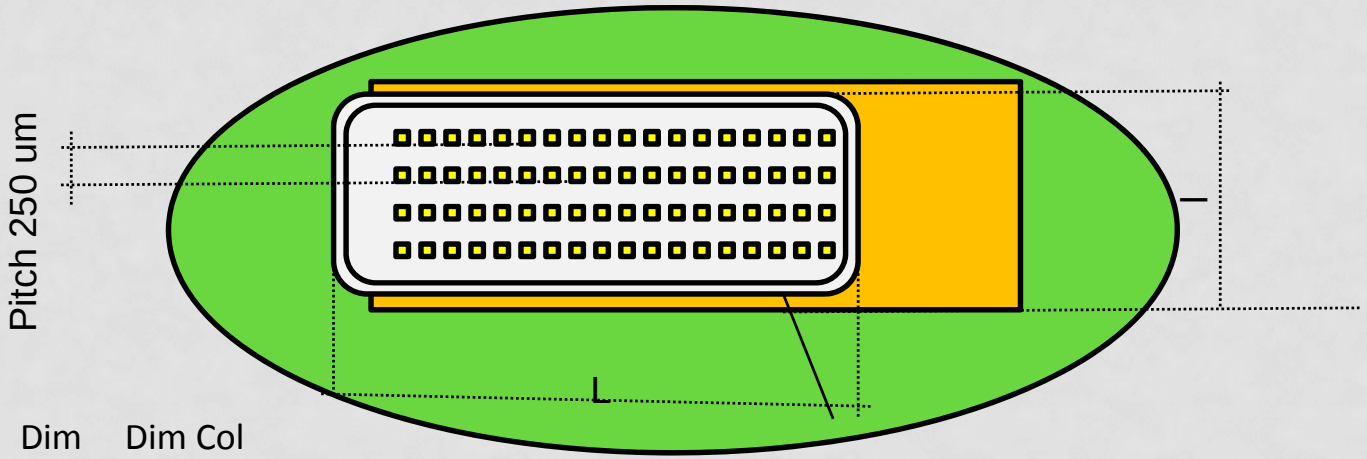


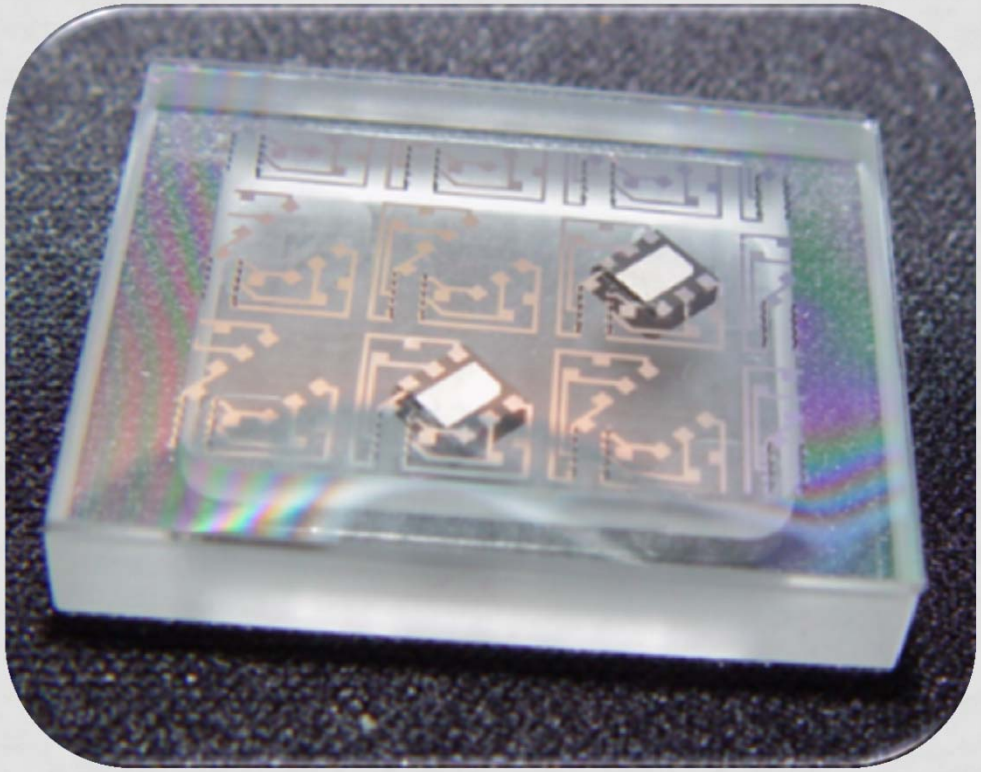
Interconnection size evaluation:

Interconnec - tions	n Rows	n Col	Casing + inner space	Dim Row (L) microns	Dim Col (l) microns
72	1	72	1'500	1'750	19'500
	2	36		2'000	10'500
	3	24		2'250	7'500
	4	18		2'500	6'000
	5	15		2'750	5'250
	6	12		3'000	4'500
	7	11		3'250	4'250
	8	9		3'500	3'750
	9	8		3'750	3'500
	10	8		4'000	3'500

Surface reduction compare to feed through technology: over 70%

Please note that this only considers the interconnections spaces and not include the real volume needed to encapsulate the electronic components.

FULLY FUNCTIONAL IMPLANT WITH HIGH DENSITY FEED-THROUGH



TECHNOLOGY PLATFORM FITTING TO TRENDS

- Increased safety of patient:
  - resistant, long term stability, biocompatible
- Longer autonomy:
  - ultra-low power electronics, transfer and storage
- Patient “on-line” information:
  - data computing and front-end data treatment
  - accessible real time data (mobile applications)
- Minimally invasive:
  - miniaturization, functionalization of encapsulation
- More interaction with biological elements:
  - more accurate measurement and stimulation

Proven material

RF transparency of glass

System Integration

High density Feed-through

VALTRONIC® Because Experience Matters

Thank you for your attention !