

Goals & Methods

Design, develop & test innovative devices:

- Power-MEMS : generators, actuators, sensors, supply & control
- Bio-Mag-MEMS : μ fluidics for biomedical applications

Approach:

- Creativity, innovation, pioneering...
- Scale reduction laws & magnetic interactions

Analytical calculation tools and MEF:

- Dimensioning / optimisation of Mag-MEMS

Technologies:

- Prototypes, demonstration modules, models
- Integration of materials: μ -magnets, active hybrid materials
- Integration of functional devices



Magnetic μ SYSTEM MAG-MEMS : MAGNETIC MICROSYSTEMS

Scientific activities

• Micro-energy:

Energy harvesting, μ -sources of energy μ -actuators / μ -motors/ μ -generators

• Bio-Mag-MEMS:

μ -fluidics for biomedical, lab-on-chip, μ TAS

Diamagnetic levitation: digital μ Fluidics, μ Objects

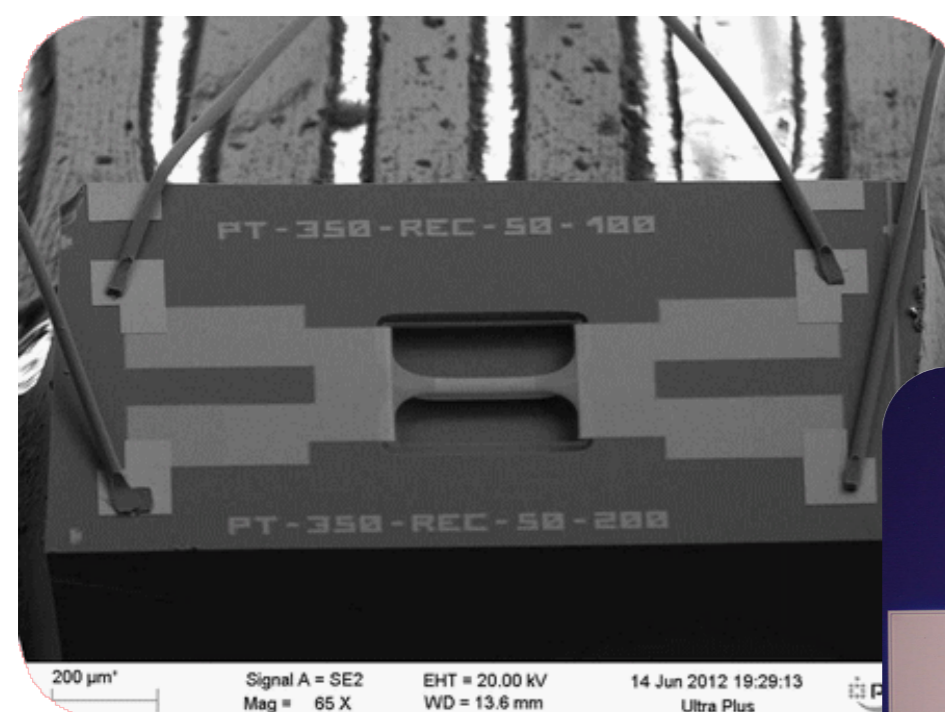
Experimental facilities

Embedded within CIME Nanotec @ MINATEC:

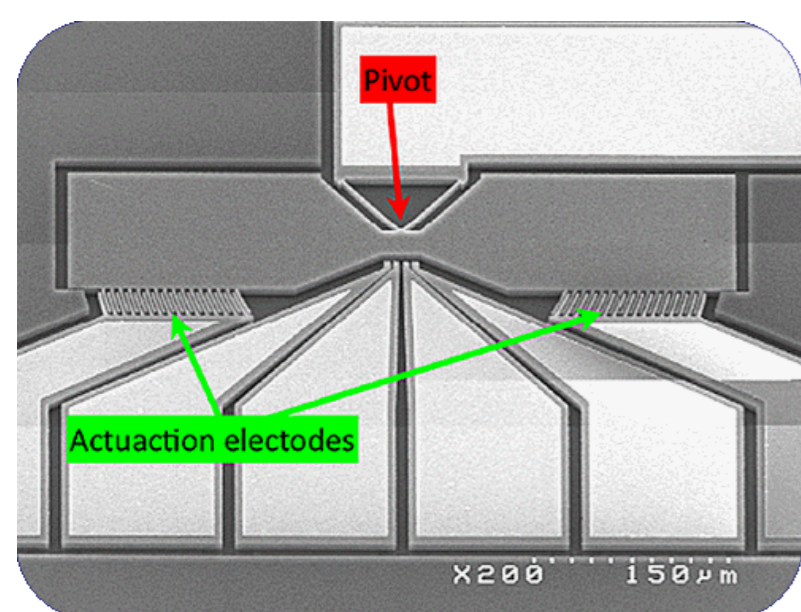
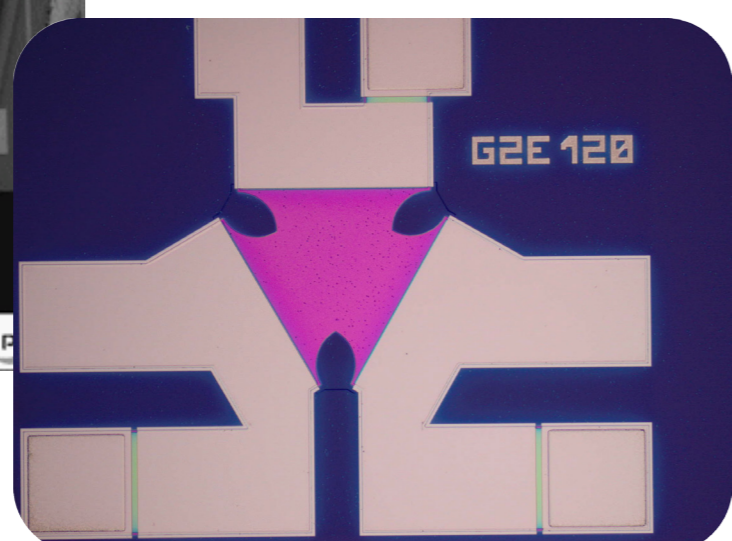
- Microsystems shared platform ($C^2\mu$) (characterisation, prototypes, tests)
- PTA clean room
- Nano-Bio & μ -fluidic shared platforms

We benefit from the pioneering know-how of Institut Néel & CEA-LETI: creation & integration of functional materials, Si micro-technologies...

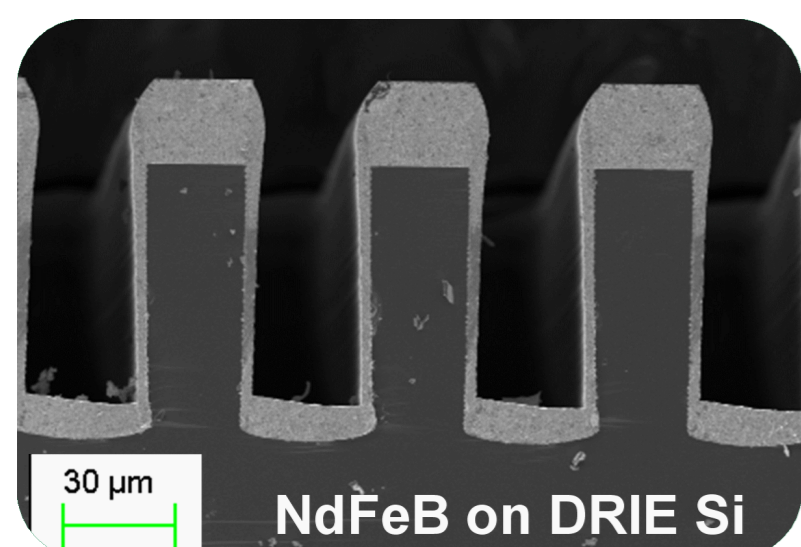
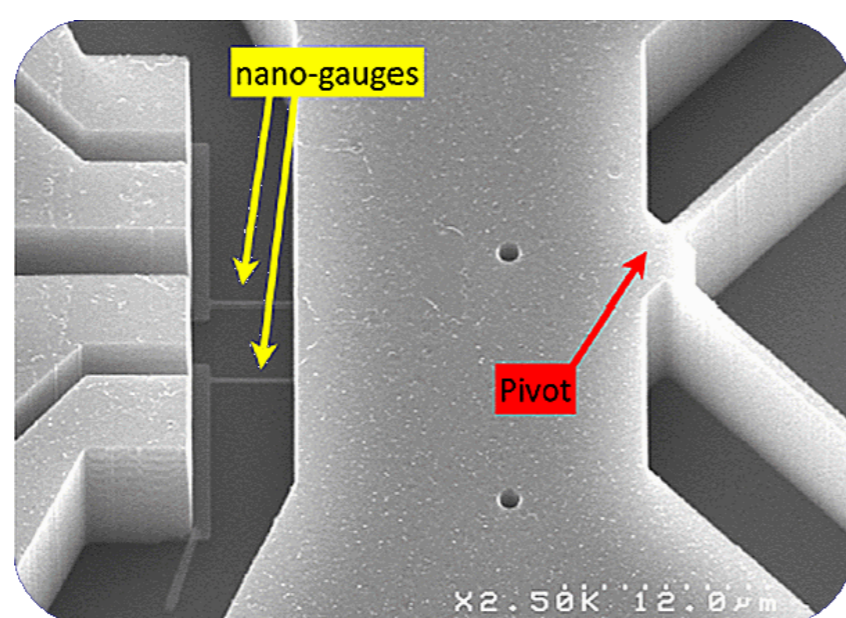
Integrated active materials



Hybrid transducers for voltage controlled actuation piezoelectric / magnetostrictive multilayers (@ CEA-LETI)



M&NEMS multi-modal sensor (directional magnetic & inertial) : Co-integration of nano-structured anti-ferromagnet multilayer, nanometric strain-gauges, & electrostatic feedback control (@ LETI)



Integrated high-performance magnets : thick NdFeB μ -magnet layers (30 μ m) deposited onto textured Si substrate (Institut Néel, with LETI)

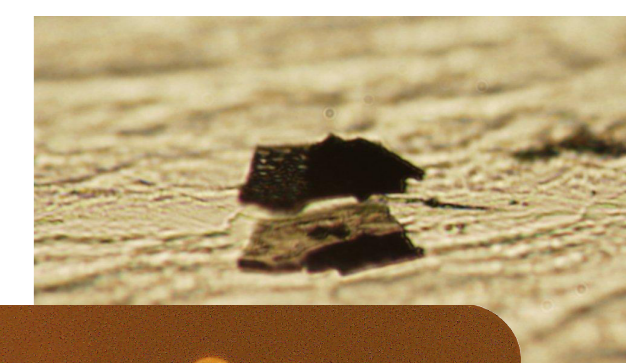
Productions

- 1- Integrated 8 mm \varnothing 3-phase dual-layer stator on Si for planar μ -machine / μ -generator (with LETI for DGA)
- 2- Array of 1 mm² μ -switches (bistable, 30~120 μ m out-of-plane) Integrated FeCoP magnets, Si / Glass flip-chip-assembly (w/CEA-LETI)
- 3- diamagnetic μ -droplets (H₂O 30~150 μ m) in levitation in a magnetic pit, in electrostatic repulsion (w/ CEA-LETI)
- 4- NdFeB magnet flake (thickness 5 μ m) in levitation over diamagnetic HOPG graphite substrate (with I. Néel)
- 5- Bio-chemical reaction enhanced by superparamagnetic tagging. μ -fluidics for easy & fast diagnostics (with LMGP+Néel)
- 6- Bacteria tagged by magnetic nano-beads, trapped on 50 μ m μ -magnet array (with I. Néel & Ampère /Lyon, for ANR Emergent)
- 7- Voltage control of magnetic easy axis orientation in nano-structured piezo-magnetic multilayer (with CEA-LETI)

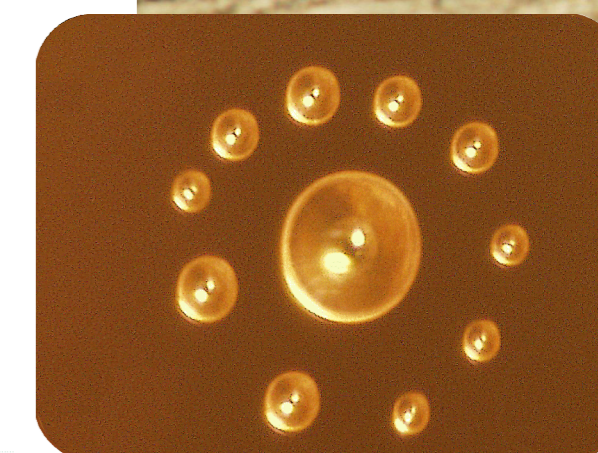
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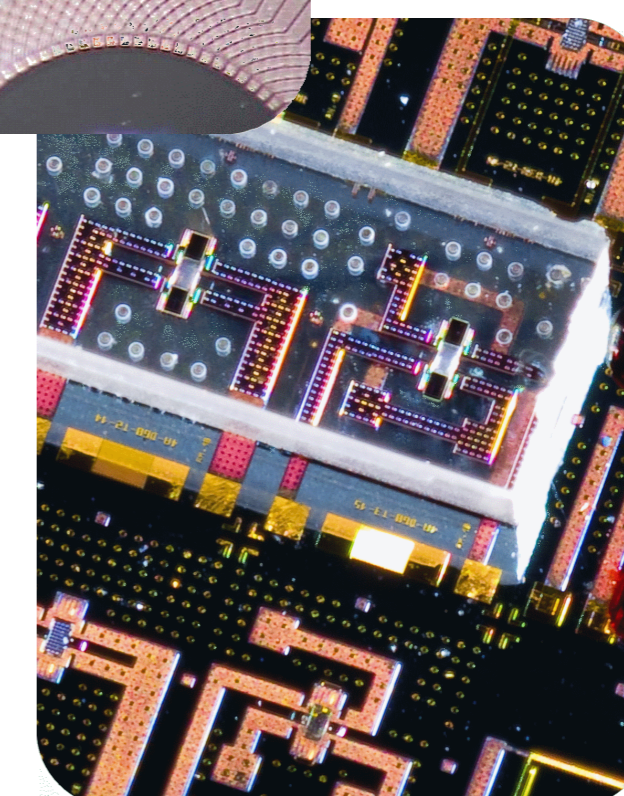
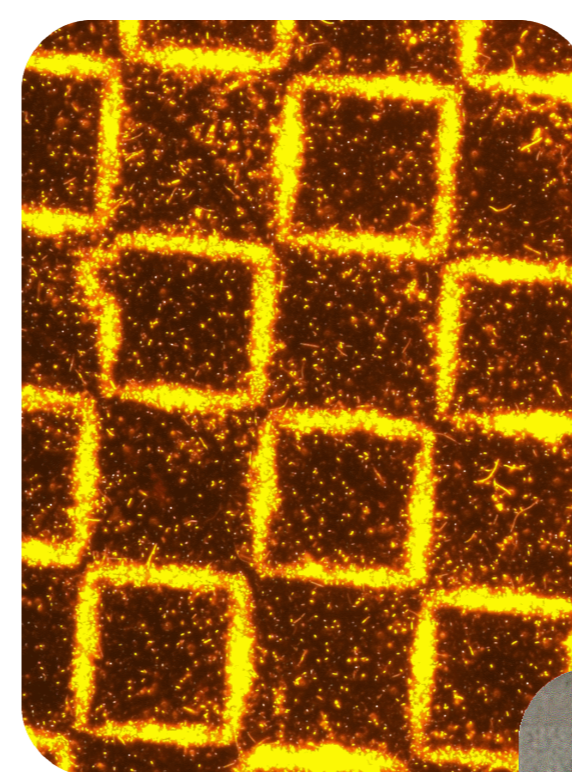


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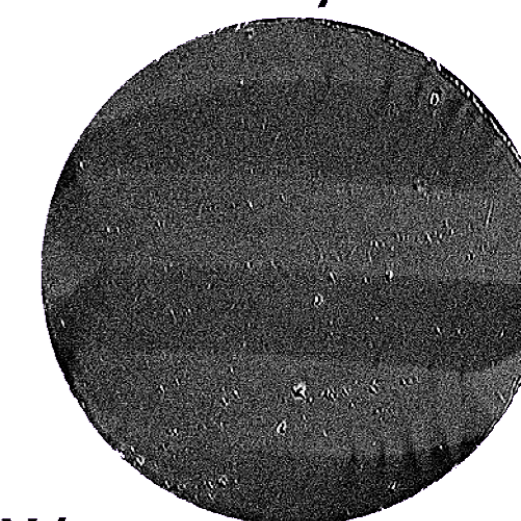


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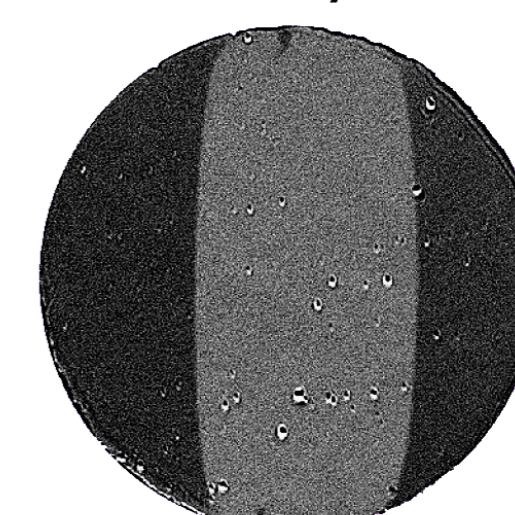


3 MV/m

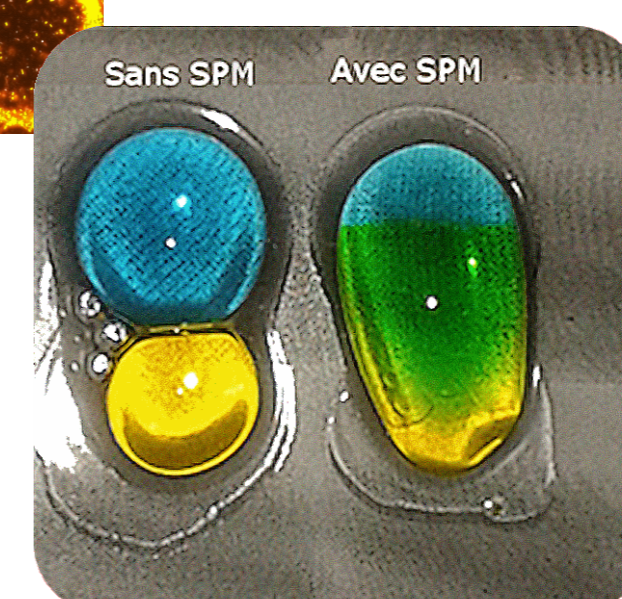


-1 MV/m

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Collaborative projects

MINATEC / $C^2\mu$

micro-characterization, clean room (CIME Nanotec)

Institut Néel

integration of high performance magnets, exotic magnetic materials, diamagnetic levitation, bio-medical devices

LETI-CEA

integration on Si, μ -fabrication clean room, integrated active materials:

- PZT, magnetostrictive, shape memory

LMGP micro-fluidic bio-medical applications

TIMA energy harvesting, Ultra-Low-Power

Ampère-Lyon (& Biomis)

micro-manipulation of cells :

- superparamagnetic nanoparticles tagging
- diamagnetic trapping & selection

G2Elab

- SYREL MEMS sensors for Smart Grid supervision
- MAGE analytical design of Mag-MEMS design & constrained optimization
- EP smart power management
- MDE energy harvesting electrostatics for μ -fluidics & droplets

