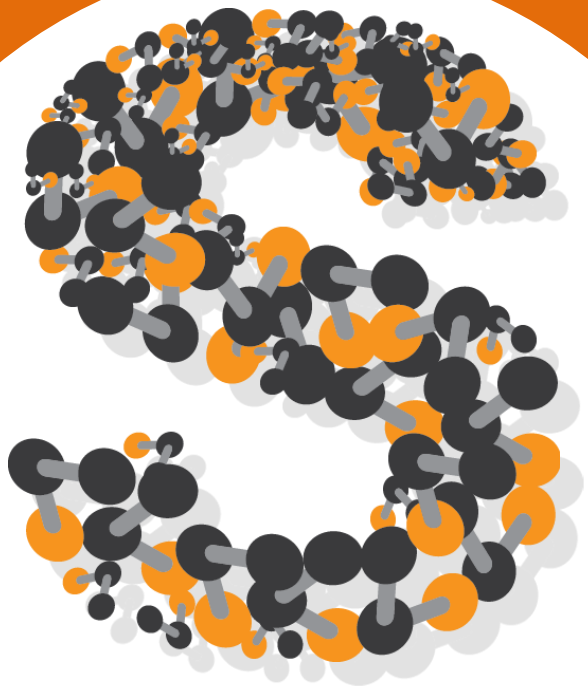
Silicon Friendly Materials and Device Solutions for Microenergy Applications



SiNERGY

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Welcome

1st Workshop

30-9-2014

SINERGY

Title: Silicon Friendly Materials and Device solutions for Microenergy Applications

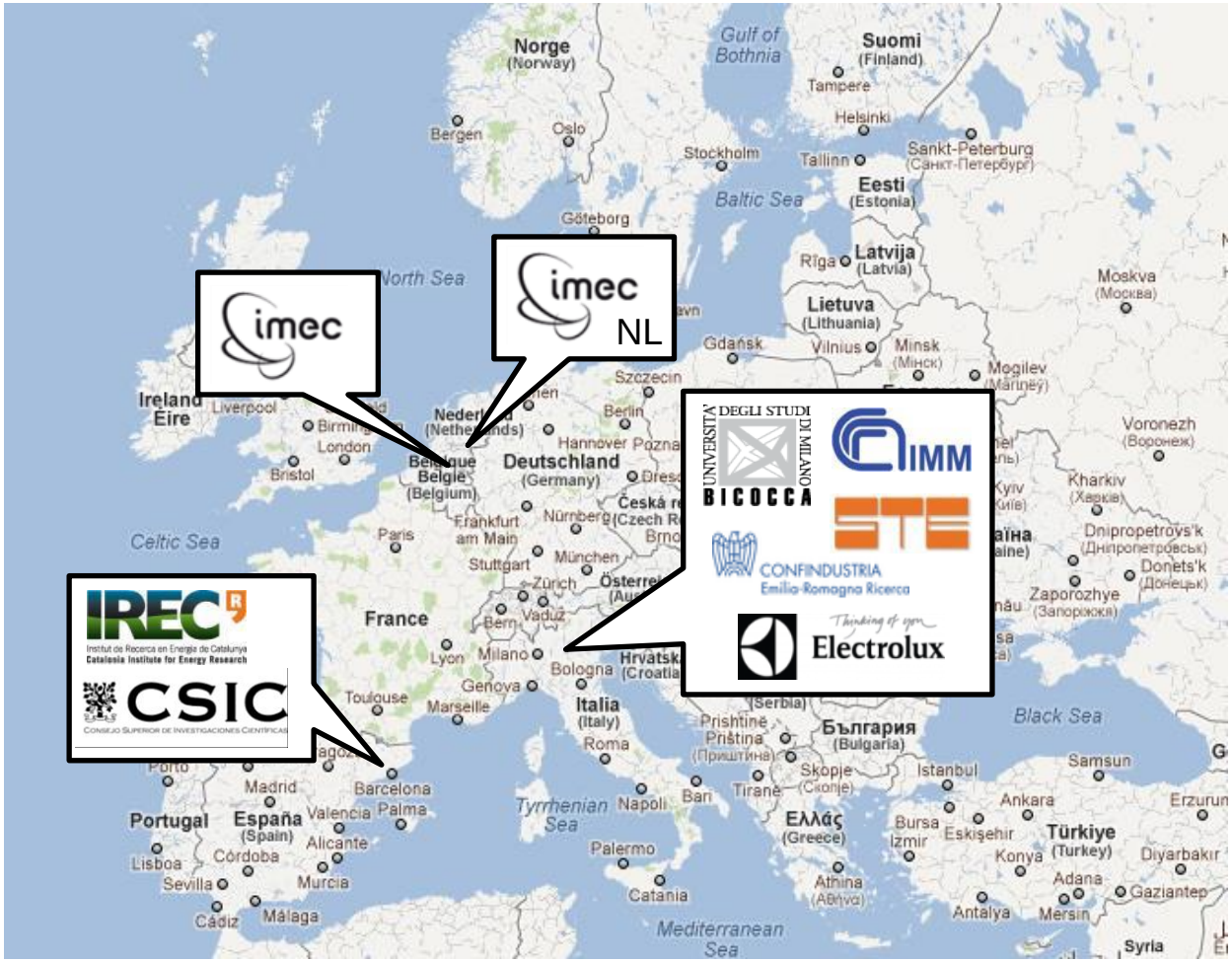
Acronym: **SiNERGY**

Call/topic: NMP.2013.2.2-4 Materials solutions for durable energy harvesters

Duration: 36 months

Funding: 3,794,913.00 € (4.824.460.00 €)

Partners: 9 (4 countries) - **coordinated by** Luis Fonseca (CSIC)



9 partners
(ES, IT, BE, NL)

Coordinator:
CSIC
(IMB-CNM)

Goal: Silicon materials and Silicon technologies & architectures for long term autonomy microenergy solutions

Focus: (1) Technology development at device level (2) Systems integration feasibility

Devices: (1) Harvesters based on thermoelectrics (2) Harvesters based on mechanical vibrations (3) thin film / 3D batteries

Why microenergy solutions:

Small Power for the next Big Thing

IoT

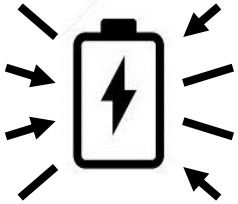
INEZ TORRE-/ONN

T SENSORS SUMMIT™ FOR TRILLION SENSOR ROADMAP

Functional autonomy

Energy autonomy

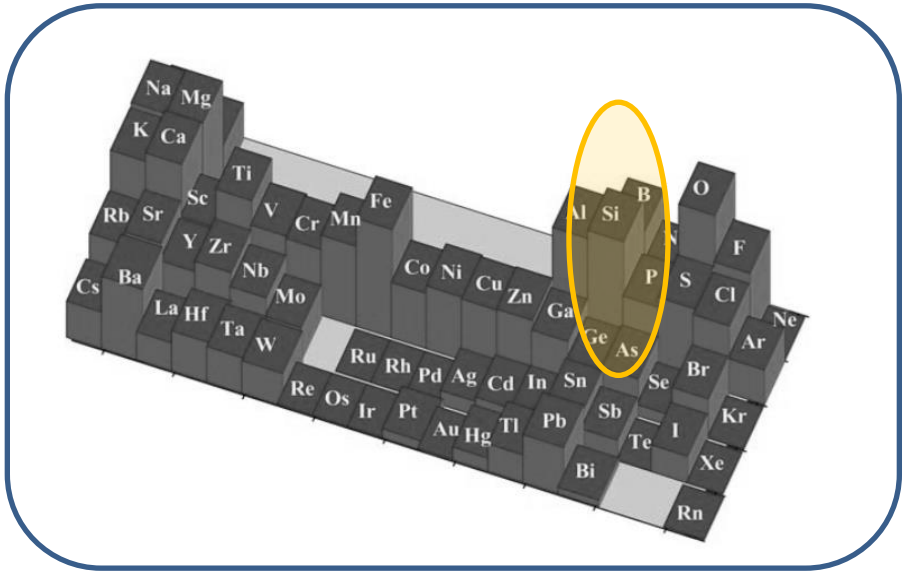
grid off-grid



Energy harvesting

Get the energy or replenish the battery from the environment

Why Silicon materials and architectures:



Abundant material
Mature technology
Cost effectiveness and economy of scale
Miniaturized systems and dense architectures

Applications scenarios:

- Predictive maintenance

Rotating-reciprocating machines
Large shop floors
High number of nodes
Difficult servicing

Test-bed for vibrations and thermal harvesting

- Tire Pressure monitoring

Intelligent tire
Large market volume
Small size

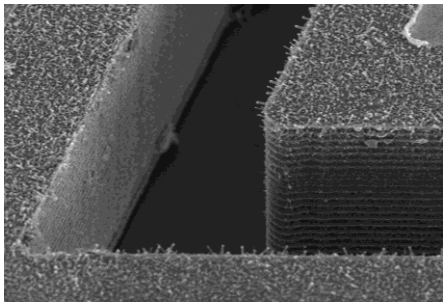
Test-bed for vibration harvesting

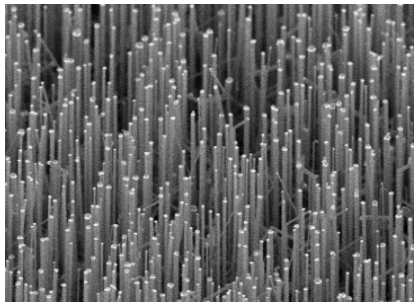
If many (sensors/harvesters), better...

- Small

Less material and
energy consumption

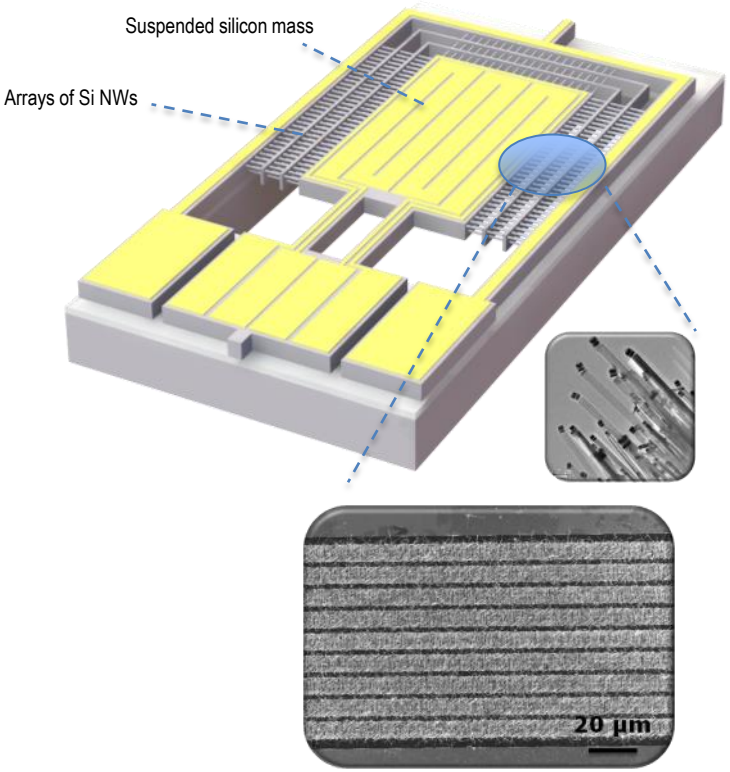
- but internally 'dense'



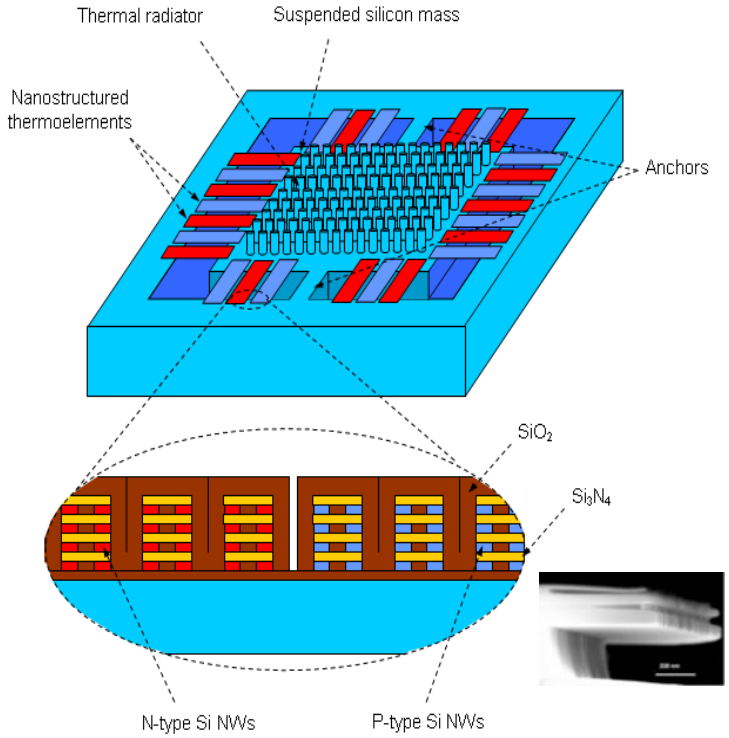


  - **Micromachining**: free surfaces & volumes (coupling with the environment)
  - **3D architectures** (where to integrate nanomaterials)
  - **high aspect ratios / high density features**

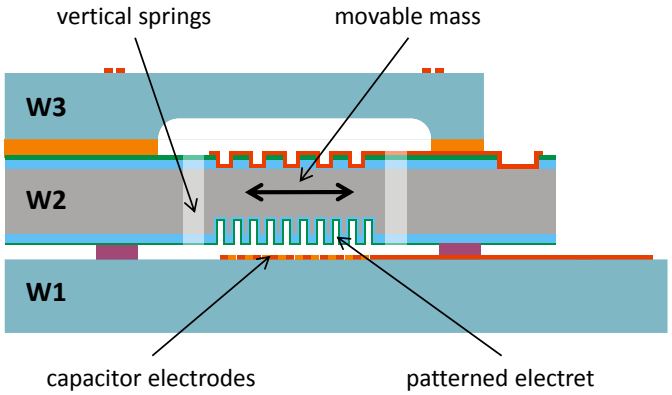
- 3D microstructures
  + bottom-up SiNWs

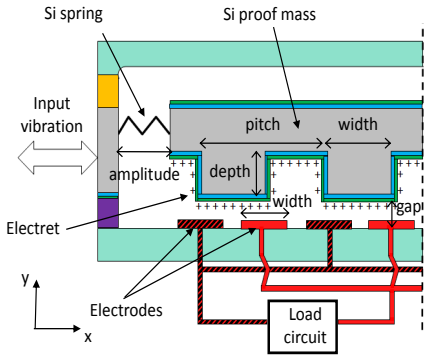


- 3D microstructures
  + top-down SiNWs

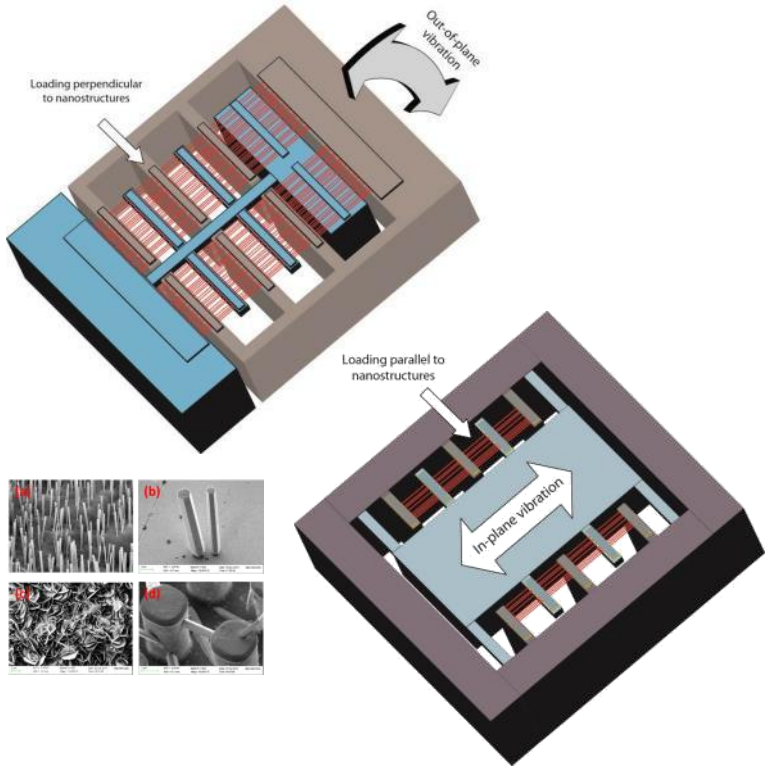


- 3D microstructures
  + electrostatic





- 3D microstructures
  + piezoelectric



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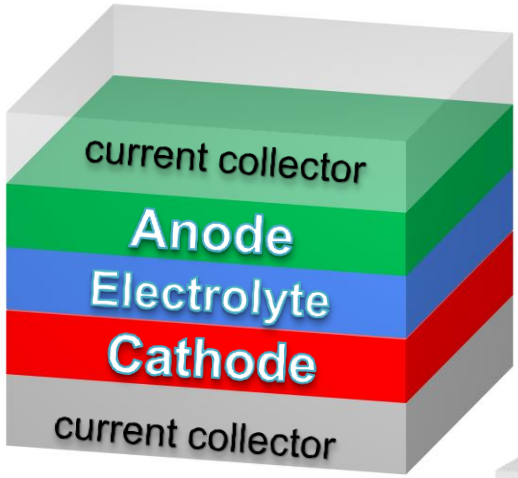
- Materials for Si compatible batteries

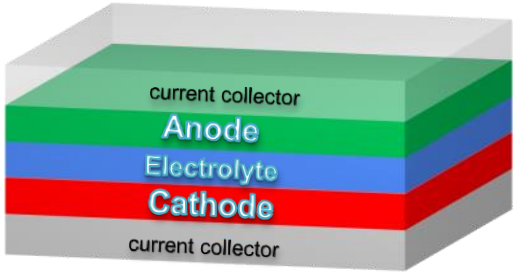
Thick film



High capacity
Low power

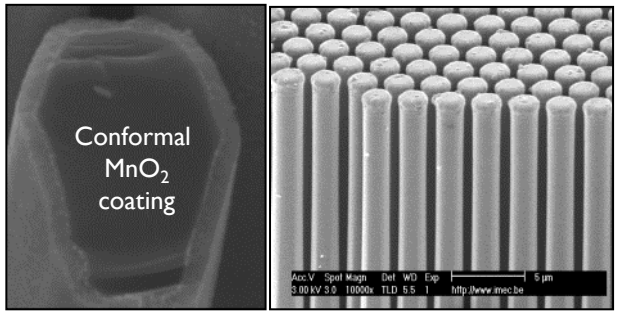
Thin film

Low capacity
High power

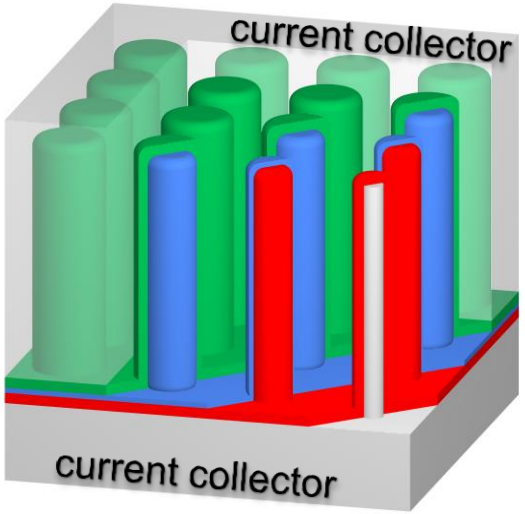


3D

- 3D microstructures



High capacity & power



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- Cross KETs endeavour

- Without an ‘install and forget’ approach IoT/ToS may not happen → (micro)energy autonomy is required
- Battery free self powered devices are the ultimate goal. EH is an option but there is still a gap between generation (µW) and consumption (mW) → secondary batteries needed
- Energy/power does not (down)scale well → high density features (3D architectures) need to be handled
- Let’s try do harvesters/batteries **with the same technologies that are already used for fabricating miniaturised sensors reliably, cost-effectively and in high numbers** → Si µn-technologies (and materials)

Workshop programme

Silicon Friendly Materials and Device Solutions
for Microenergy Applications

08:45 – 09:00	Registration	
09:00 – 09:10	L. Fonseca, CSIC	SiNERGY Vision & Goals
09:10 – 09:40	A. Ionescu, EPFL	Zero Power Tech. as Enabler of Future Smart Wearables
09:40 – 10:10	Y. Gelbstein, Ben-Gurion Univ.	Practical Considerations for Thermoelectric Materials Development
10:10 –10:40	E. Yeatman, Imperial College	Energy Harvesting from Motion for Autonomous Devices
10:40 – 11:00	Coffee Break	
11:00 – 11:30	R. Salot, CEA-LETI	Overview of lithium µ-batteries : components, manufacturing and applications
	Research Activities from SiNERGY	
11:30 – 11:45	D. Narducci, Univ. Milano Bicocca	Thermal (Micro-2-Nano) Harvesting
11:45 – 12:00	M. Goedbloed, Holst Centre	Mechanical (Micro) Harvesting
12:00 – 12:15	A. Sepulveda, IMEC	3D Thin Film (Micro) Battery
12:15 – 12:30	R. van Schaijk, Holst Centre	Integration Feasibility
12:30 – 12:45	P. Moiraghi, STE	Application scenario –Tire Monitoring Systems

This work was supported by FP7-NMP-2013-SMALL-7, SiNERGY (Silicon Friendly Materials and Device Solutions for Microenergy Applications), Contract n. 604169

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