

HARVESTORE and EPISTORE projects: bridging materials and silicon technologies for micro-energy or portable energy applications

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Low to modest
quantities of
energy
(IoT/portable)



Harvestore



Epistore

Beyond **batteries**
High density and
instant recharge

Common traits

Functional oxides materials (cost, availability, environmental friendliness)

Nanostructuration (performance)

Thin film (in case CRM are present)

Integration with (MEMS) silicon technologies

Scalability

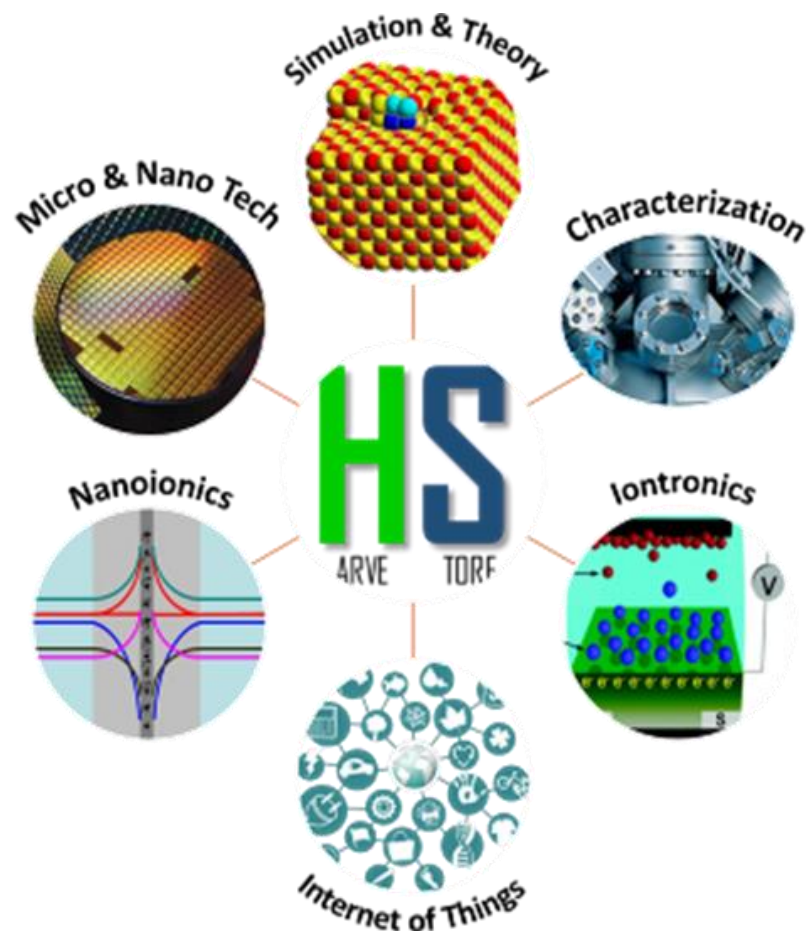
MEMS offers micromachining and extended material compatibility

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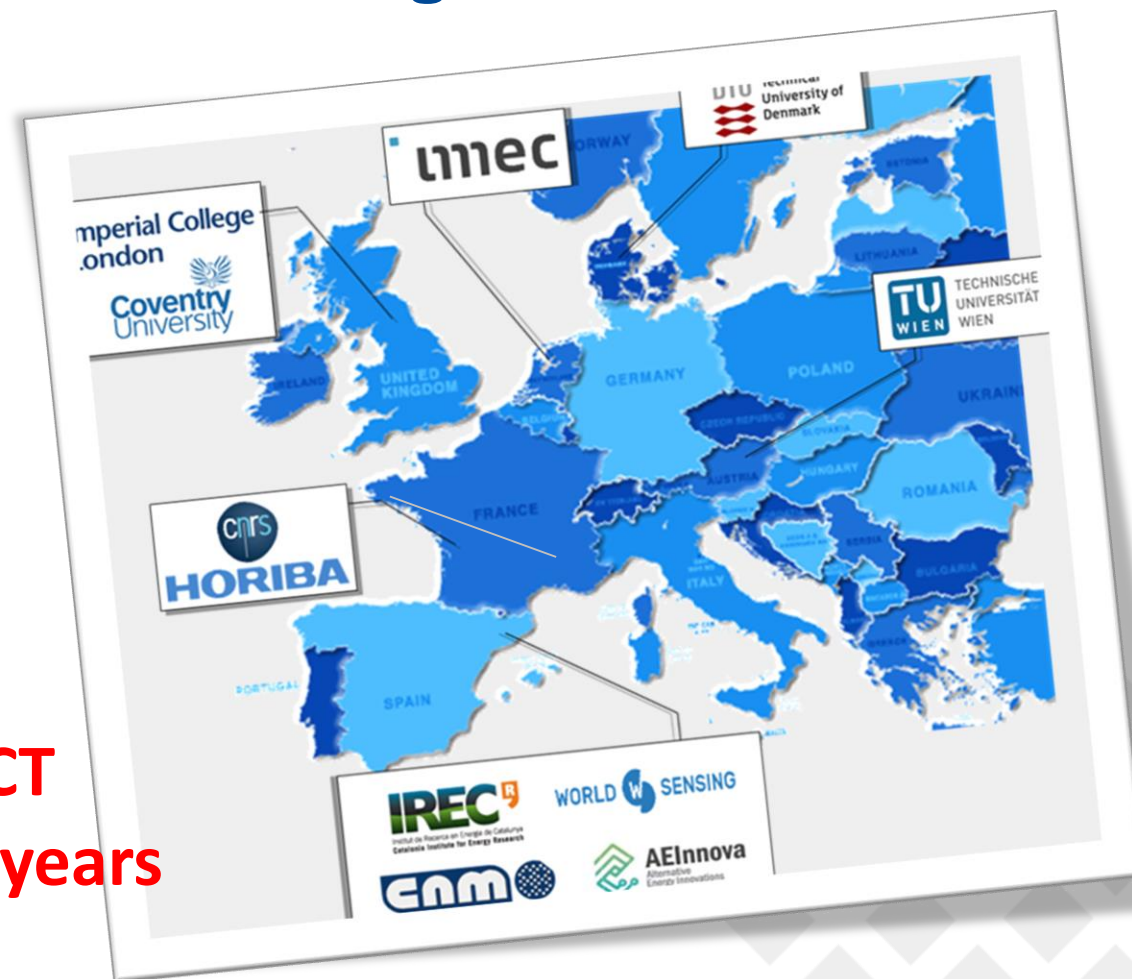
HARVESTORE

harvestore.eu

Harvestore - Energy HarveStorers for Powering the IoT



FETPROACT
Dec 2018 + 5 years



Harvestore - Energy HarveStorers for Powering the IoT

What?

- **Powering IoT nodes** from light and heat
- Footprint below 1cm^3

Who?

- Micro-Sources able to **harvest and store at the same time: μ HarveStorers**

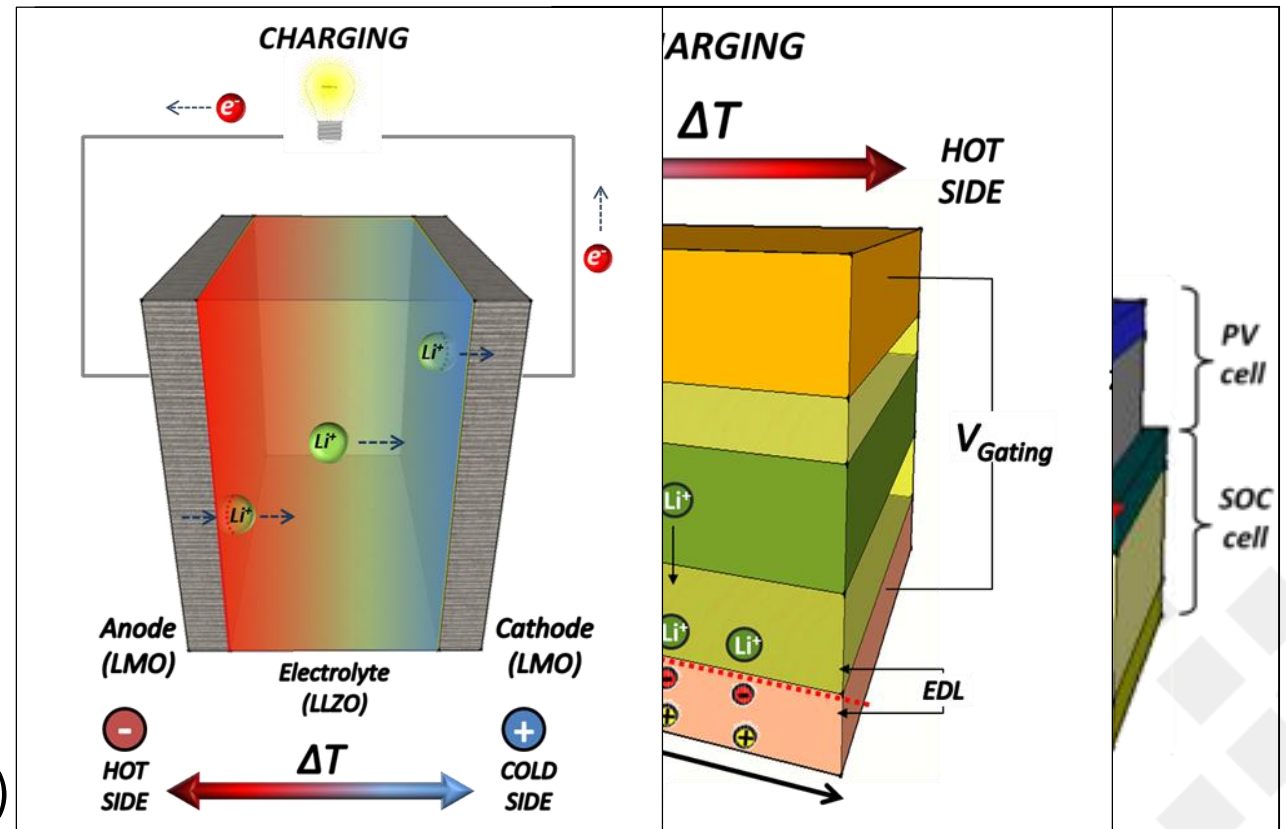
How?

- All solid oxide devices integrated in Silicon
- Synergy Nanoionics/Iontronics/MN&T
- **Nanoionics** for enhancing batteries
- **Iontronics** for enhancing harvesters (TE, PV)
- **MN&T** for integrating the synergistic enhancement and coupling with the environment

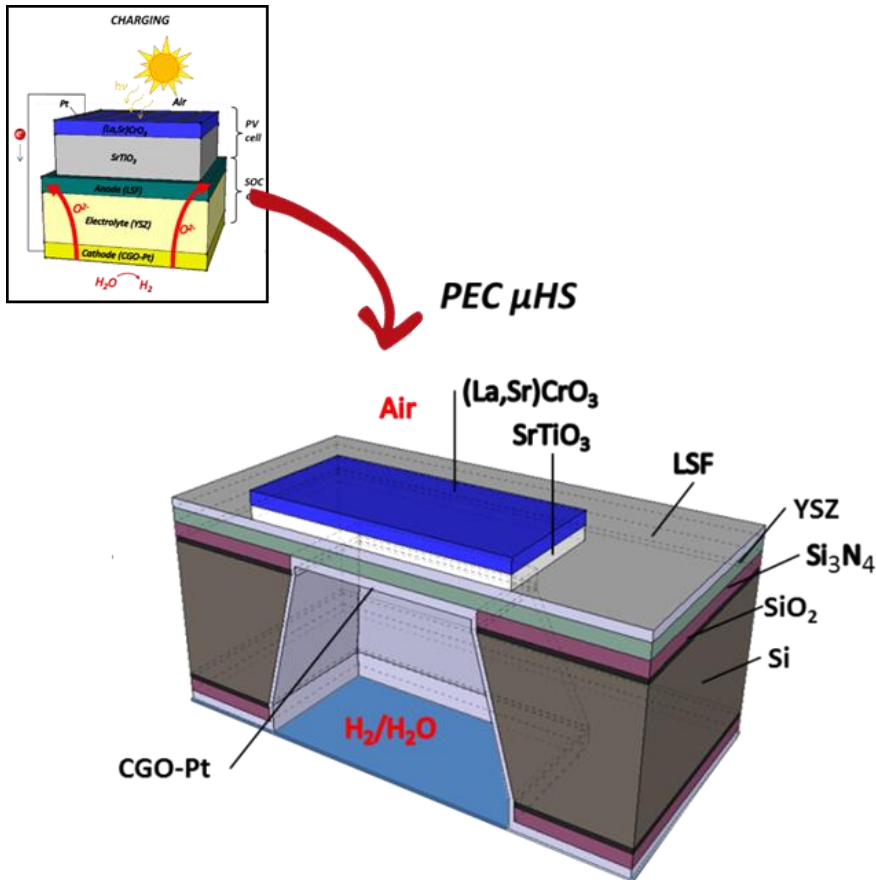
Why?

- Massive deployment of future IoT nodes needs highly dense features and scalability

Thermogalvanic battery Ion-gated thermoelectrics SOC + PV cells



Harvestore - Energy HarveStorers for Powering the IoT



Harvesting
Light is converted to an electric voltage

Storing
The voltage is used to synthesize a fuel

Releasing
The fuel powers the device

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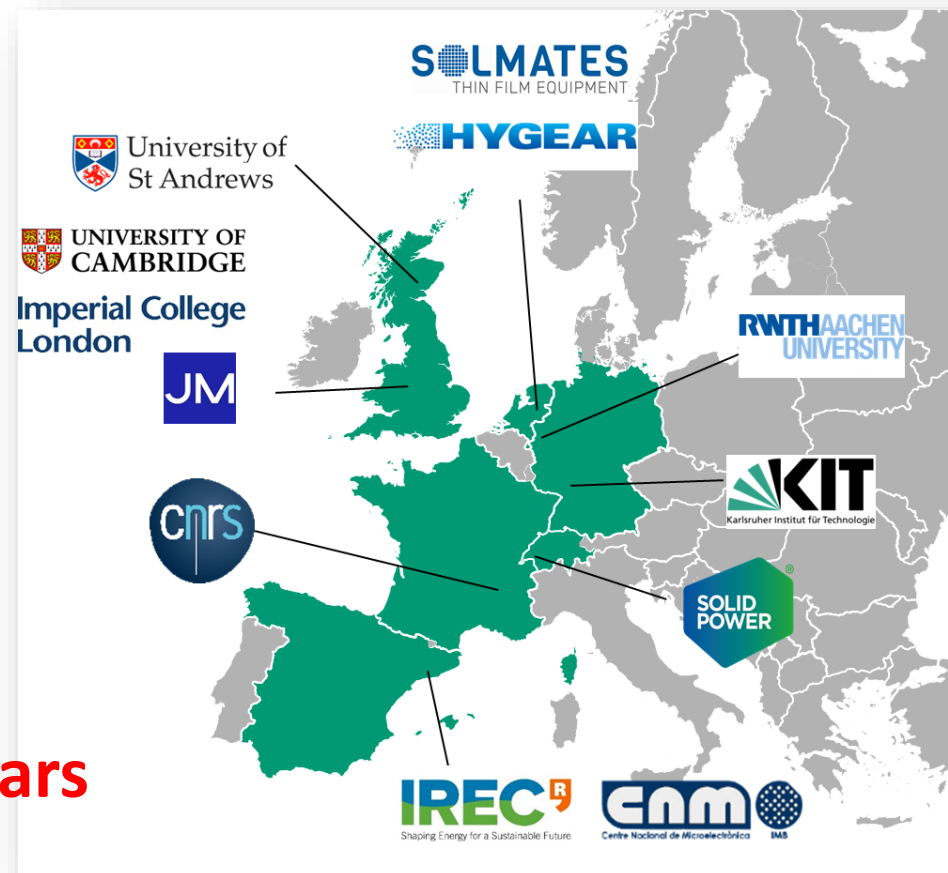
EPISTORE

epistore.eu

Epistore - Thin Film Reversible Solid Oxide Cells for Ultracompact EES



FETPROACT
Jan 2021 + 4 years



Epistore - Thin Film Reversible Solid Oxide Cells for Ultracompact EES

What?

- Renewable power storage solution
- P2G and standalone P2P

Who?

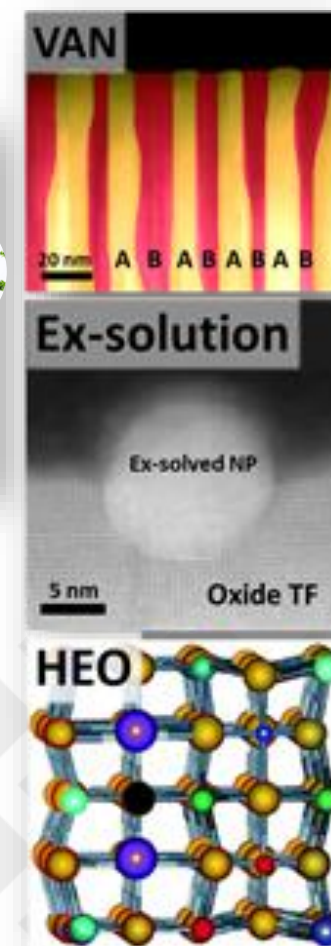
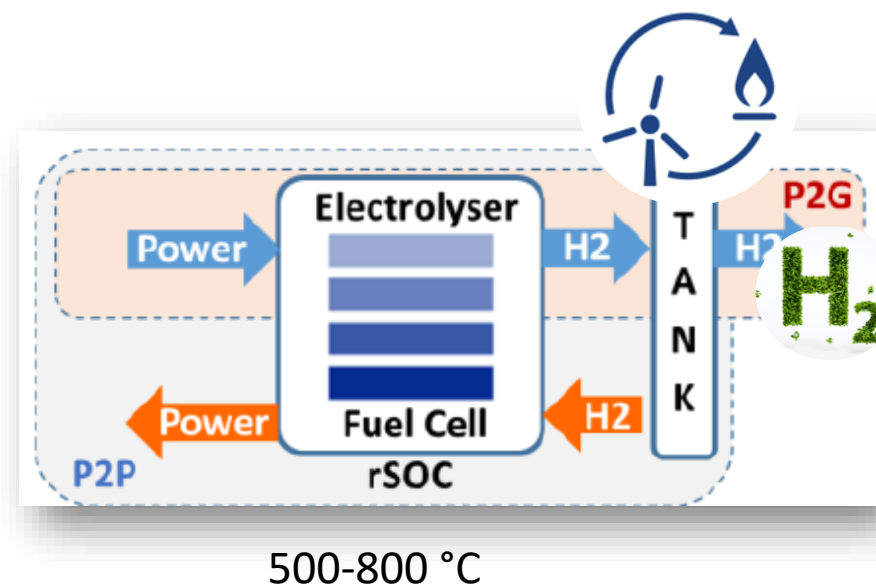
- Thin Film Reversible Solid Oxide Cells (TF-rSOC)
- Pocket-size kW-range stacks (3 cm x 3 cm x 3 cm)

How?

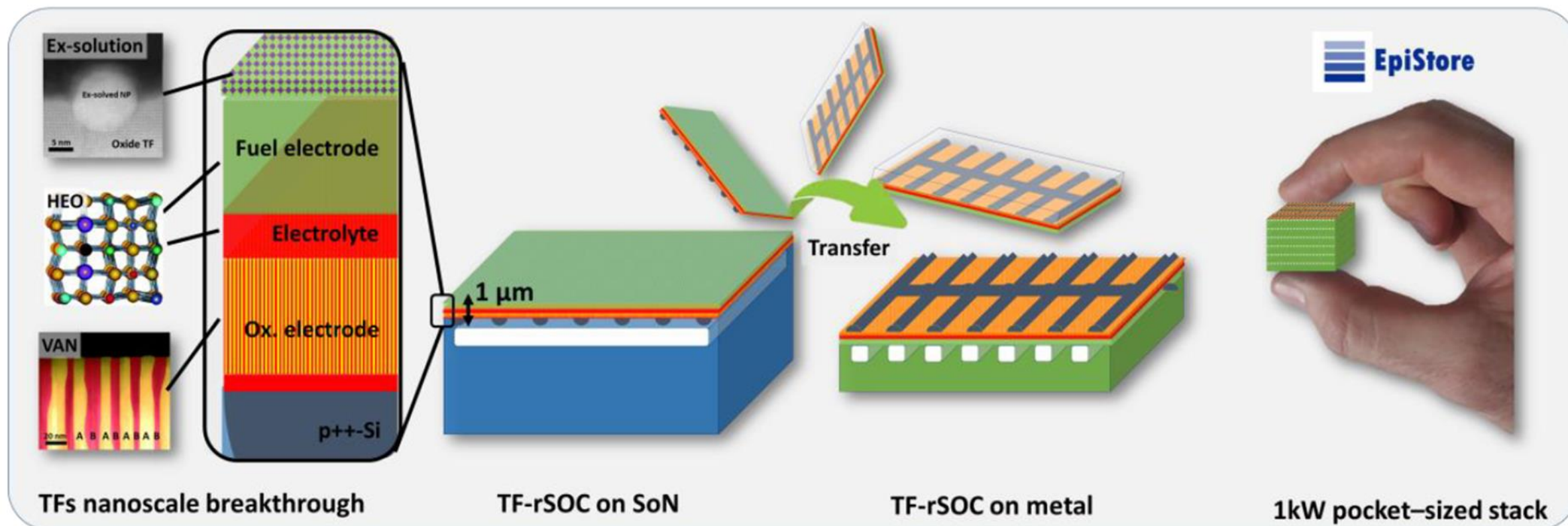
- All-thin-film devices integrated in cheap substrates
- New nanoscale concepts and materials (HF electrolytes, VANs, ex-solution, HEOs)

Why?

- Need for seasonal energy storage scalable solutions with an ultralow content of CRMs

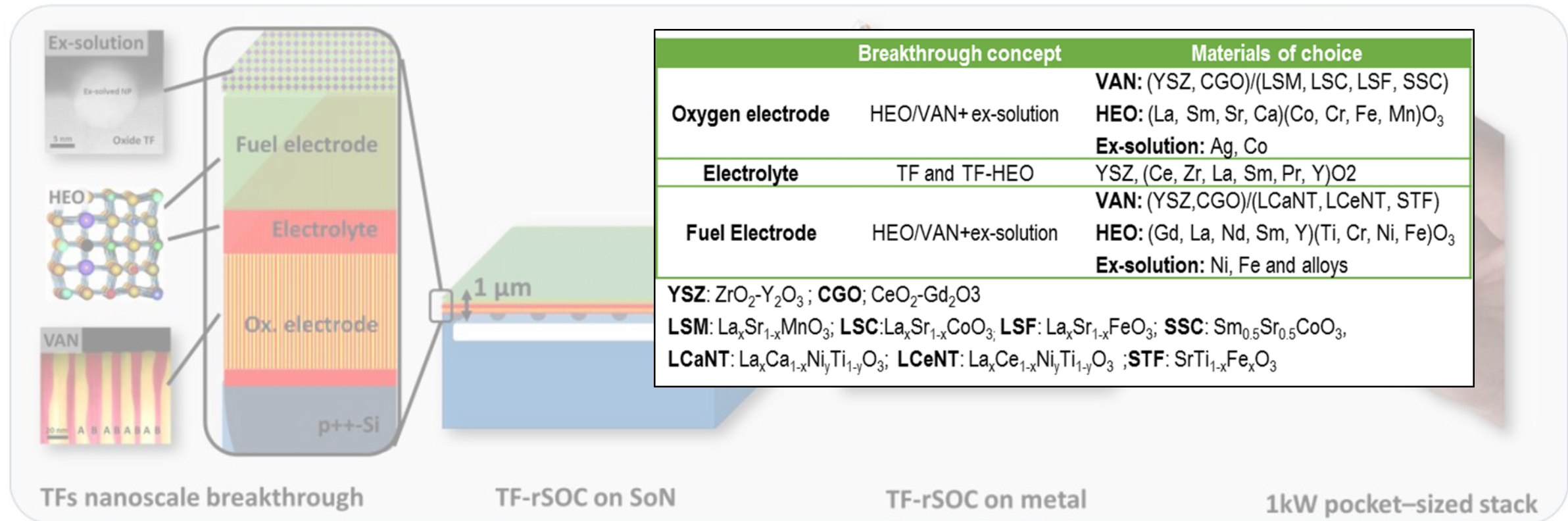


Epistore - Thin Film Reversible Solid Oxide Cells for Ultracompact EES



Total Power	T	P	Footprint	Specific power	P2G (SOEC)	P2P (rSOC)	CRMs
1kW (SOEC)	500°C	5 bar	27 cm ³ /kW	2.5kW/kg	8kWh/h η>95%	5kWh/h η>65%	0.05g/kW

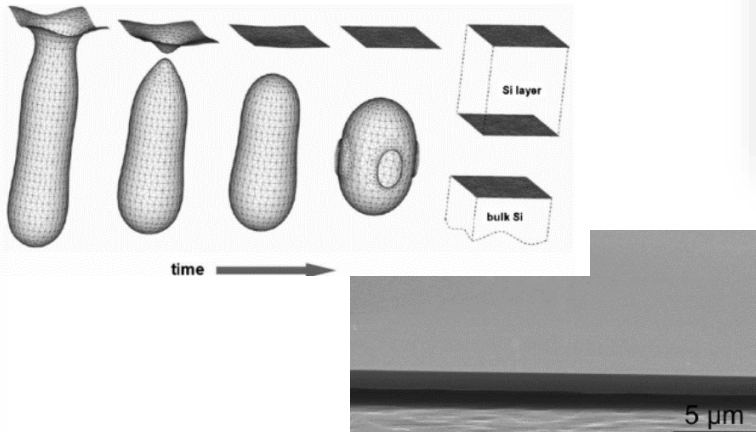
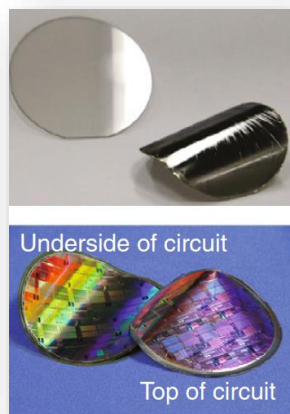
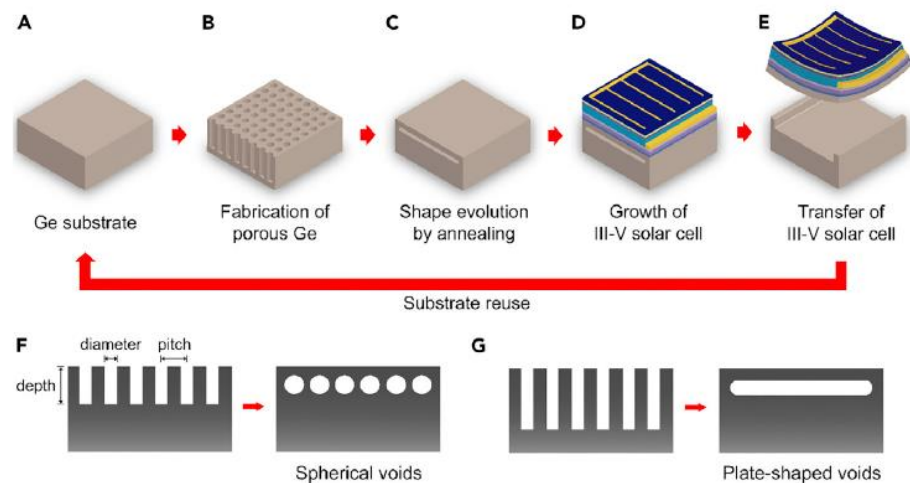
Epistore - Thin Film Reversible Solid Oxide Cells for Ultracompact EES



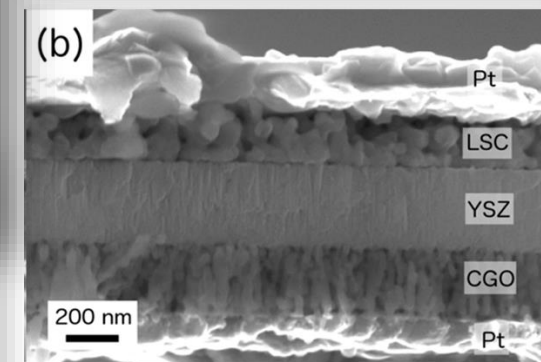
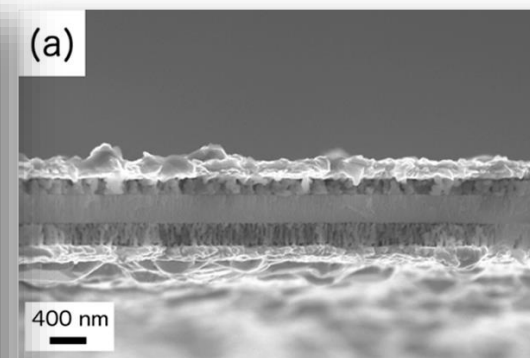
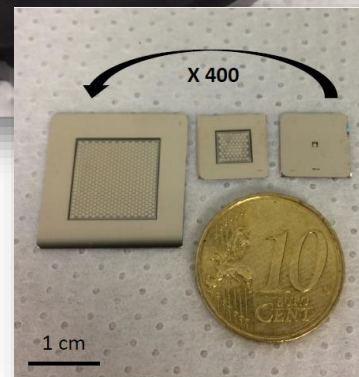
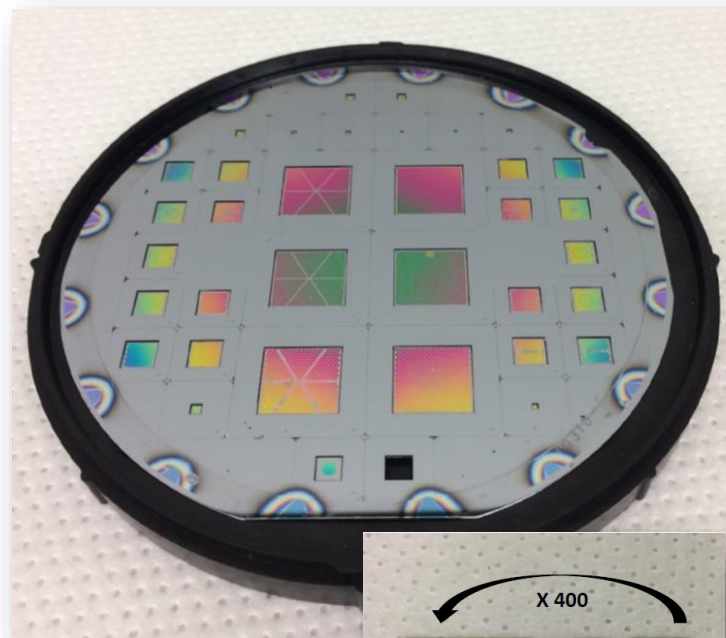
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Silicon-on-Nothing for TF-devices



Large-area fabrication of TF-SOCs



CONCLUSIONS

Challenge of the IoT: miniaturized power sources

Combination of Harvesting and Storage in silicon MEMS

Working on a new family of devices: **HARVESTORE / EPISTORE**

- along the way: MNT for all-solid power sources and new characterization tools (high resolution and in-situ / in operando)



Centro Nacional de Microelectrónica



IMB



CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

CSIC

Thanks for your attention

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