

Triboelectric generators based on intrusion-extrusion of non-wetting liquids into-from nanopores

LUIS BARTOLOMÉ/YAROSLAV GROSU

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This project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017858



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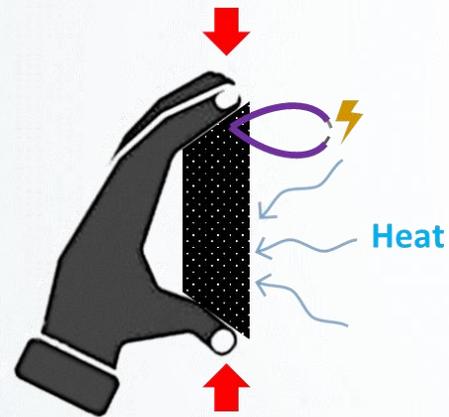


1. Introduction

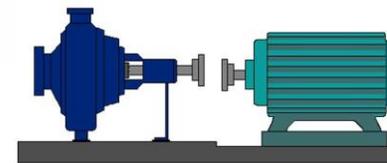


Premise & concept

Intrusion-extrusion
Triboelectric generator



Work
+ → Electricity
ambient Heat

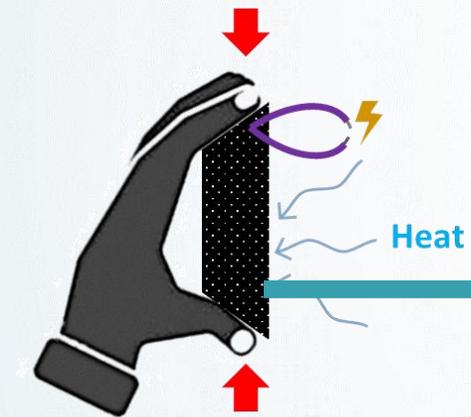


1. Introduction

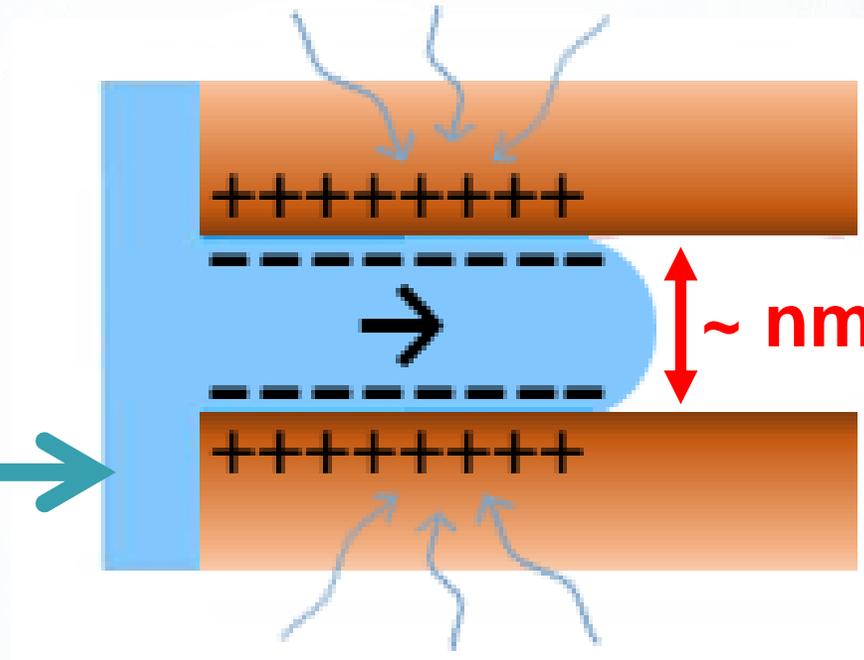


Principle & background

Intrusion-extrusion
Triboelectric generator



Work
+
→ Electricity
ambient Heat



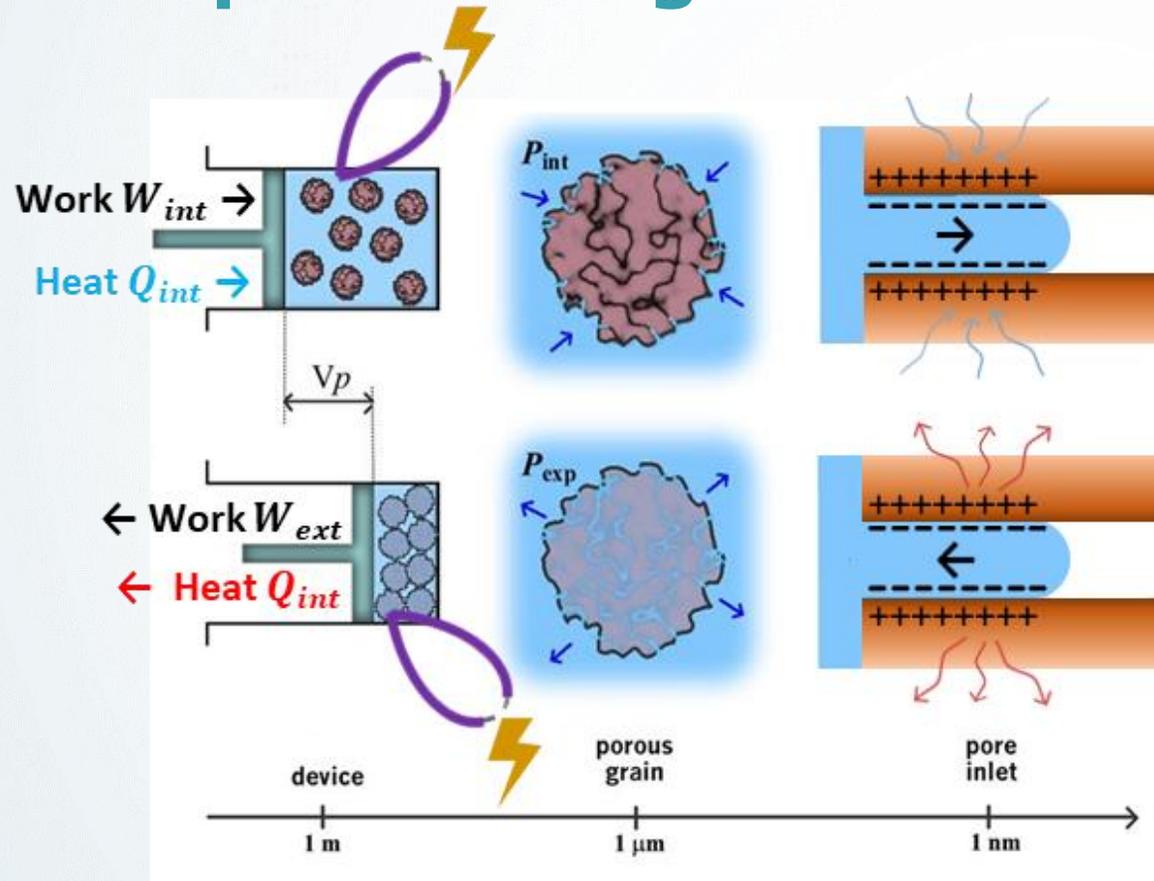
Triboelectrification



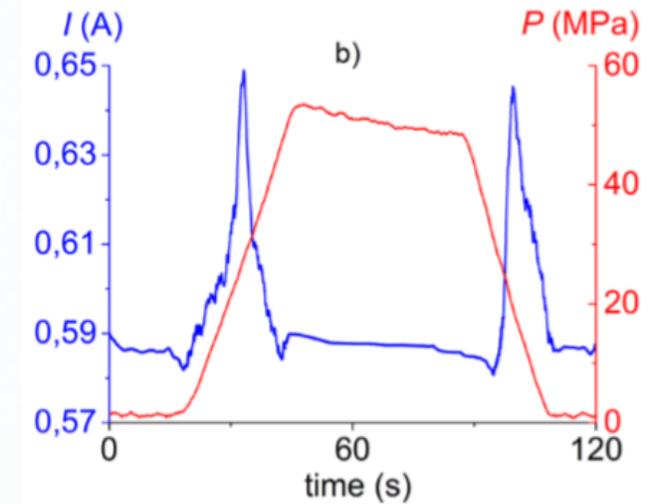
1. Introduction



Principle & background



Proved experimentally^[1-2]



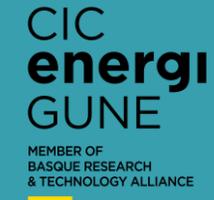
Material: **Zeolitic imidazolate framework (ZIF-8)**

Liquid: **Water**

[1] Grosu et al. Mechanical, thermal, and electrical energy storage in a single working body: Electrification and thermal effects upon pressure-induced water intrusion–extrusion in nanoporous solids. *ACS Appl. Mater. Interfaces* 2017, 9, 8, 7044–7049.

[2] Lowe et al. Effect of flexibility and nanotriboelectrification on the dynamic reversibility of water intrusion into nanopores: Pressure-transmitting fluid with frequency-dependent dissipation capability. *ACS Appl. Mater. Interfaces* 2019, 11, 40842–40849.

2. Project and objectives

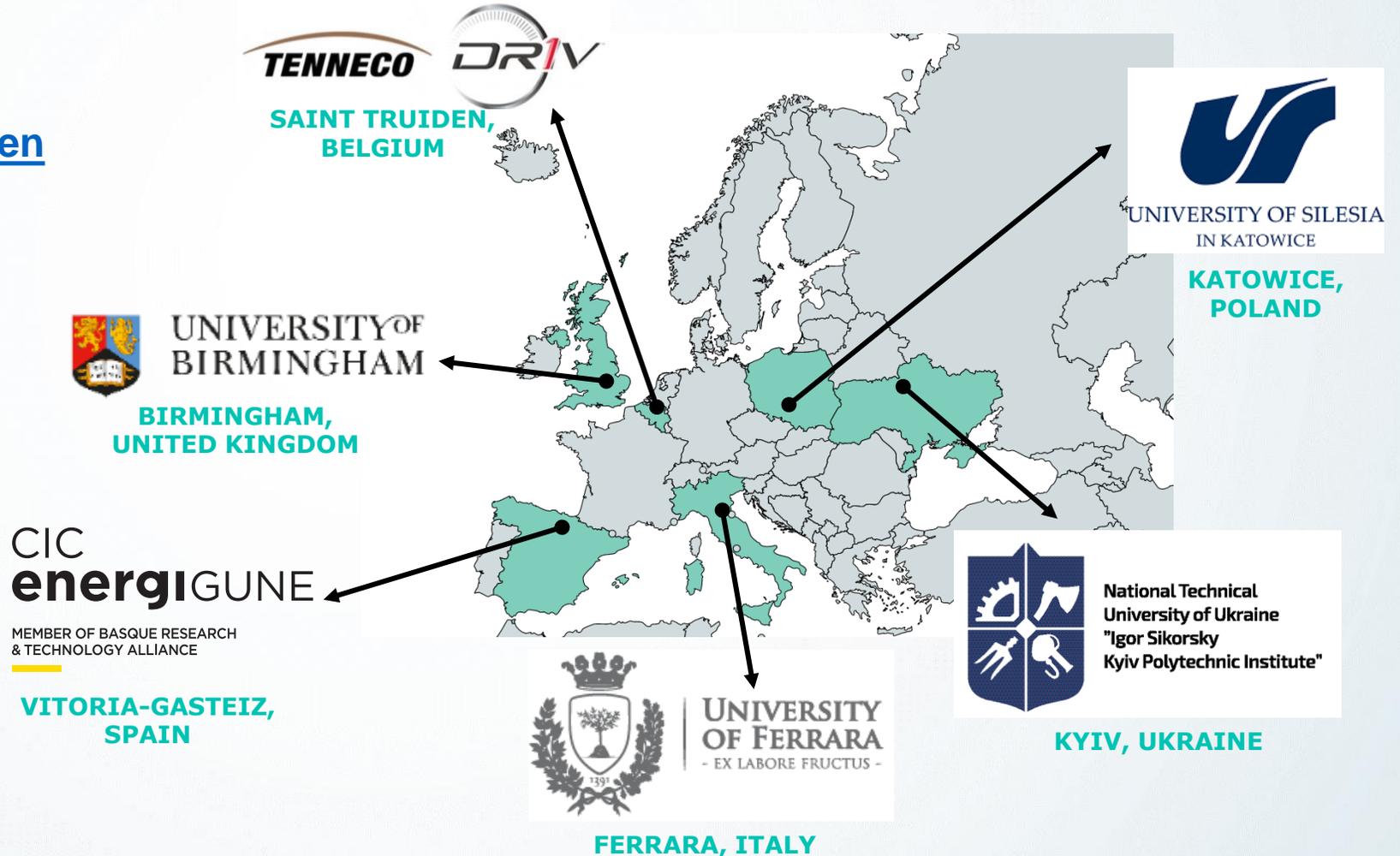


Electro-intrusion project (FET Proactive, Horizon 2020)

<https://www.electro-intrusion.eu/en>

6 Partners:

- 1 R&D Institute
- 4 Universities
- 1 Company

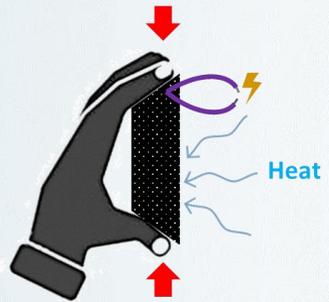


2. Project and objectives

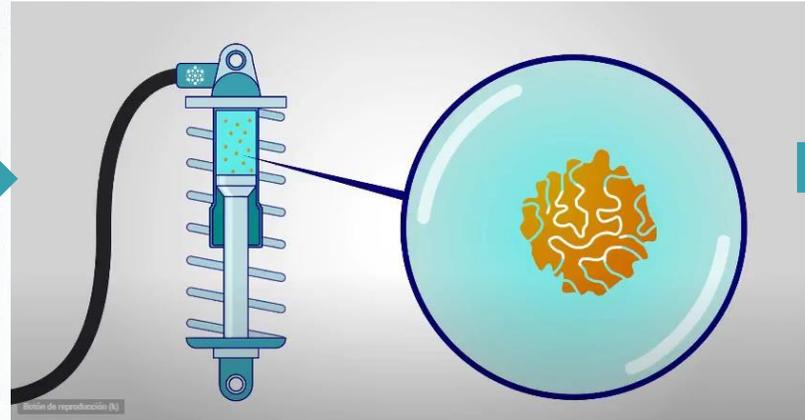


Aim & goals

Intrusion-extrusion
Trieboelectric generator

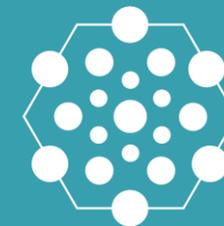


Work
+ → Electricity
ambient Heat

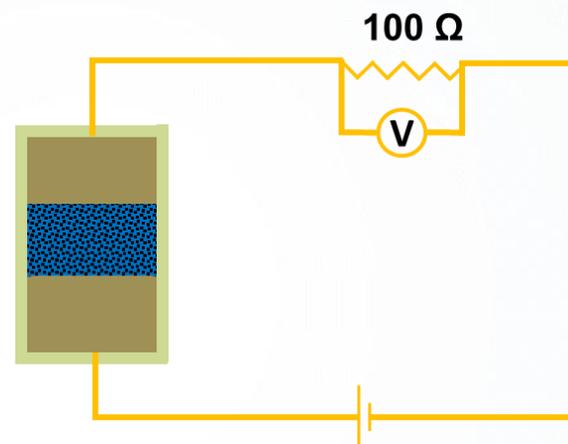
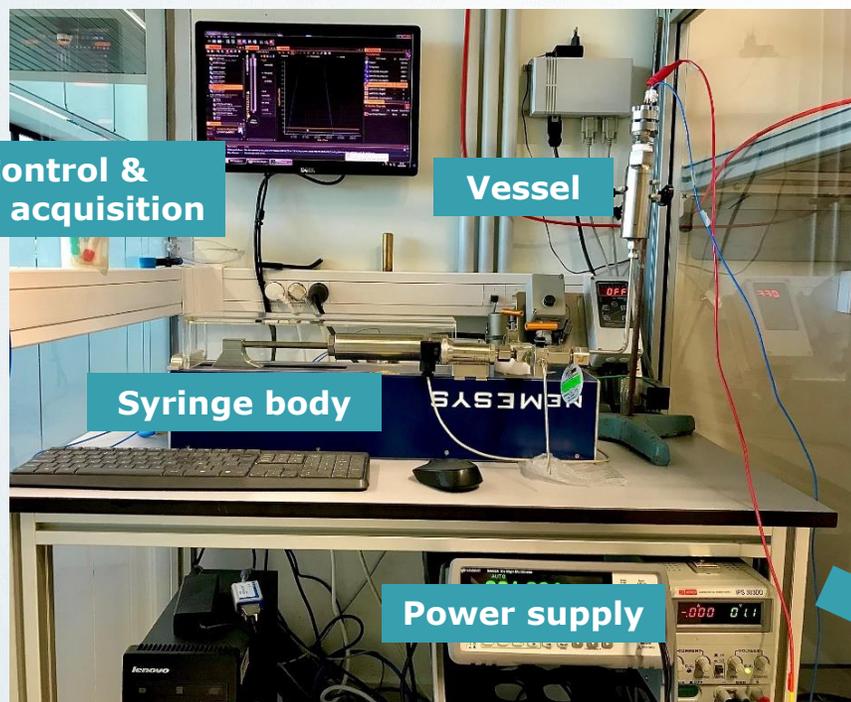


$$\frac{\text{Electricity}}{\text{Work}} > 1$$

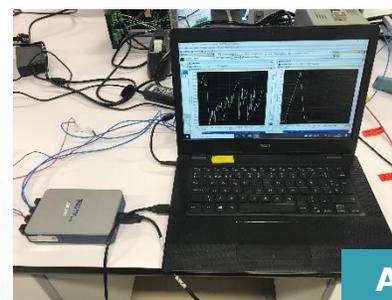
3. Preliminary results



Two-electrode configuration: Experiments



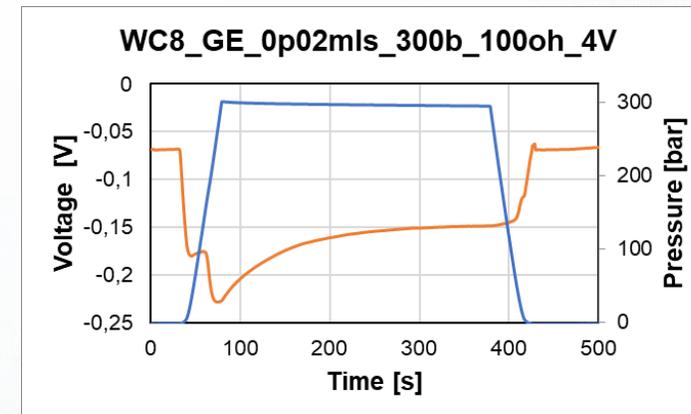
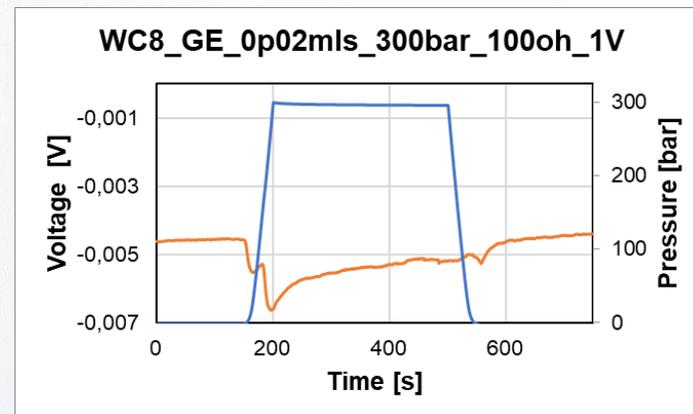
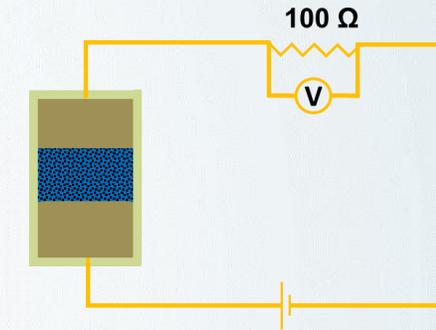
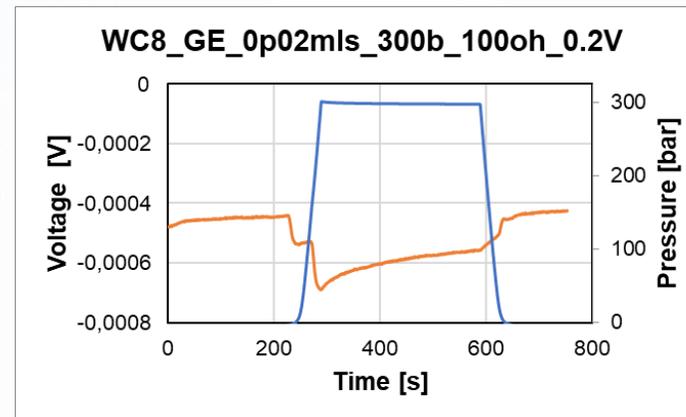
Material: **Grafted silica (C8)**
Liquid: **Water**



3. Preliminary results



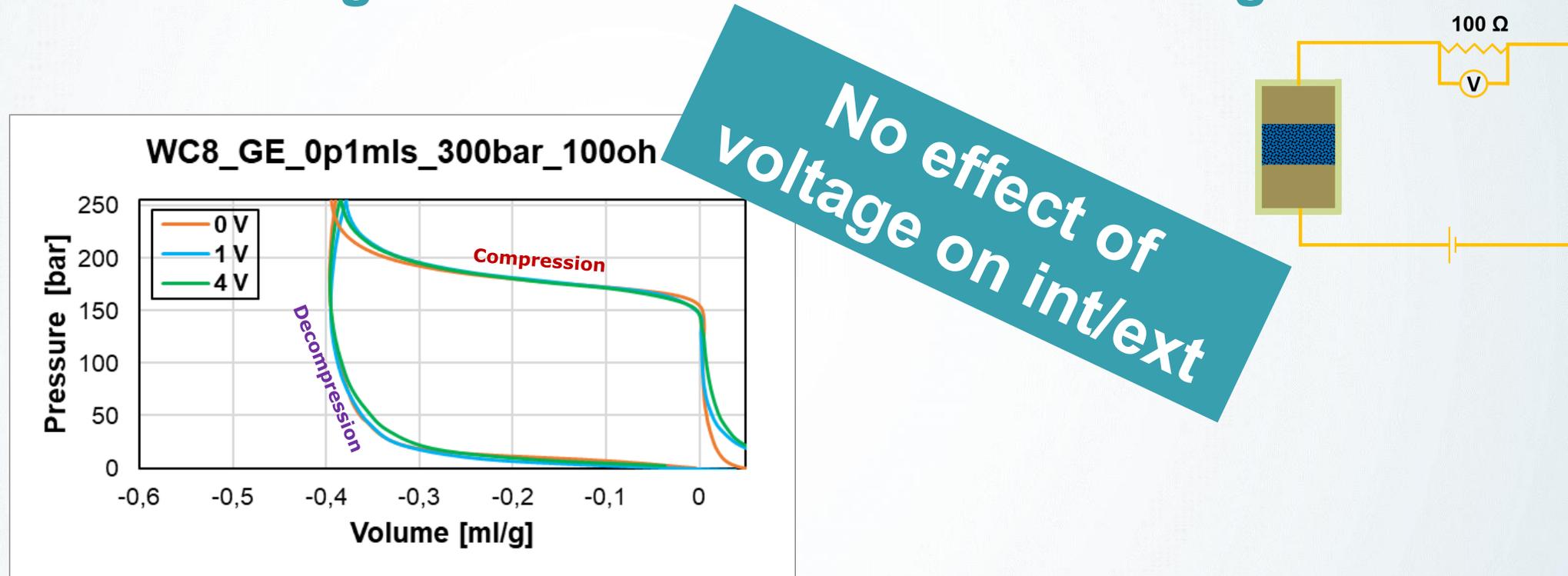
Two-electrode configuration: Results at different voltages



3. Preliminary results



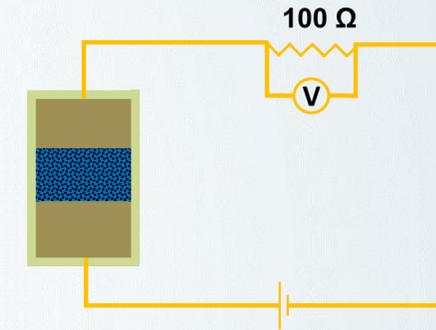
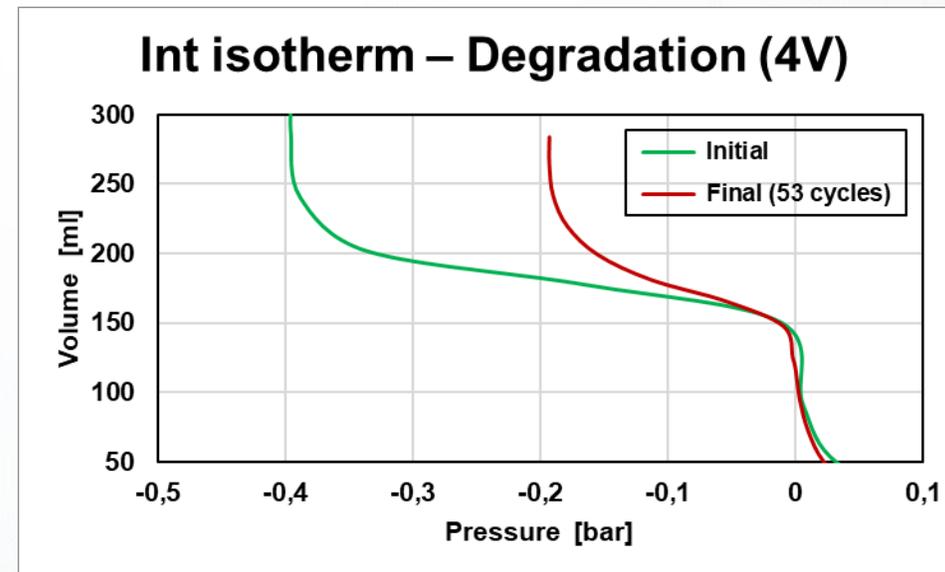
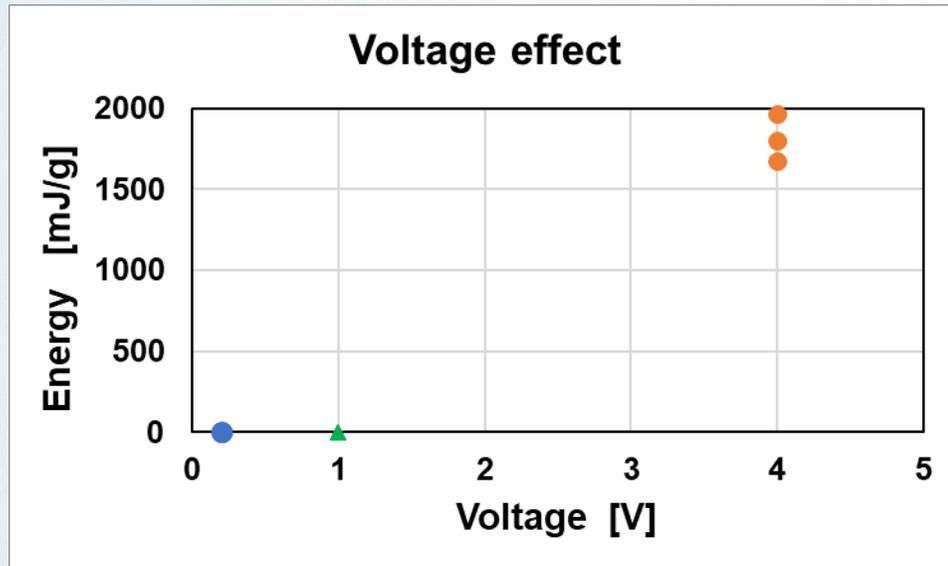
Two-electrode configuration: Int/ext at different voltages



3. Preliminary results



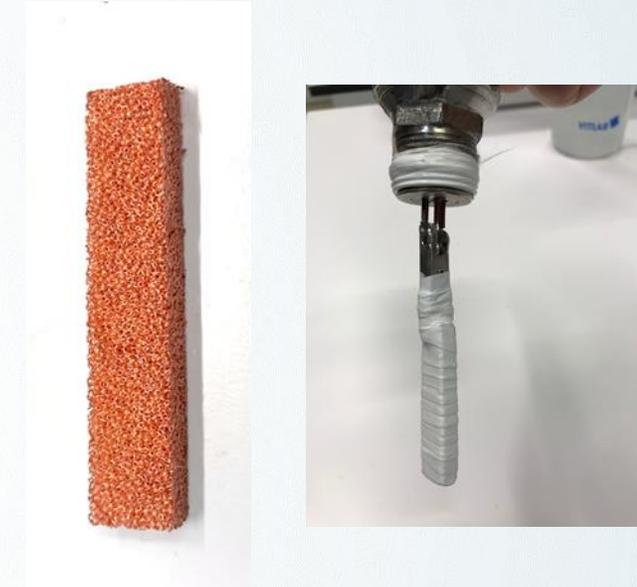
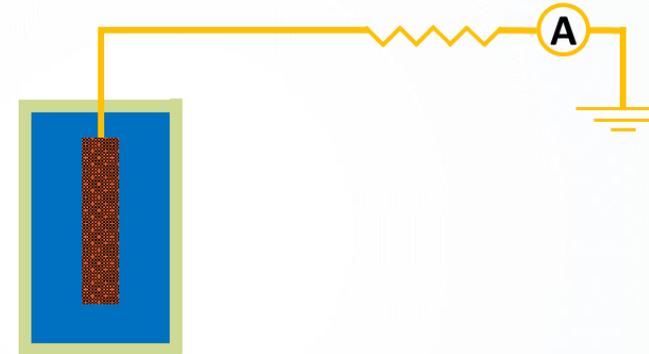
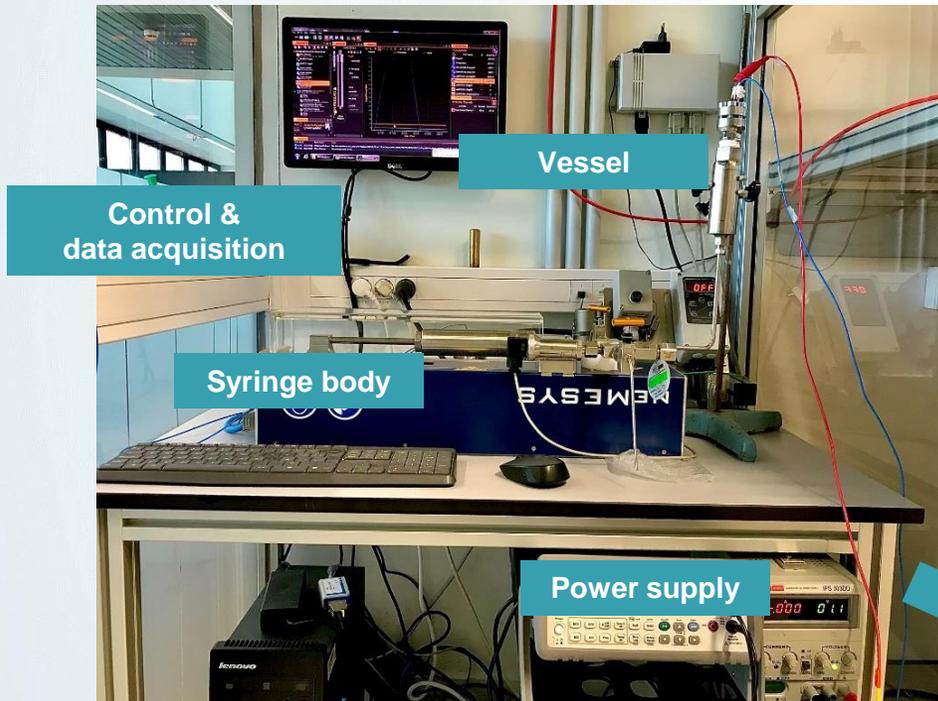
Two-electrode configuration: Energy results



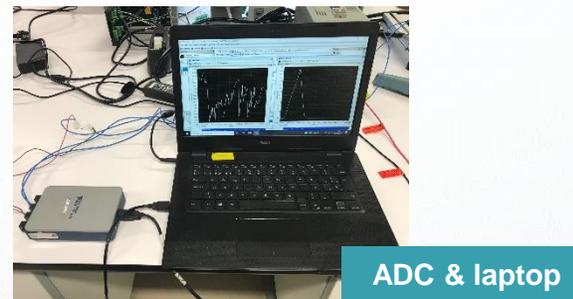
3. Preliminary results



Single-electrode configuration: Experiments



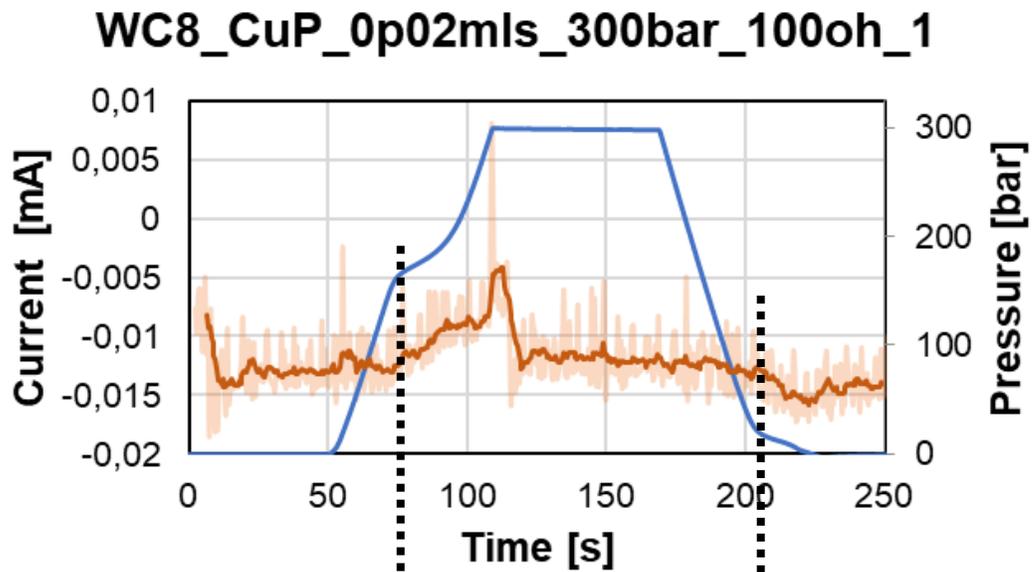
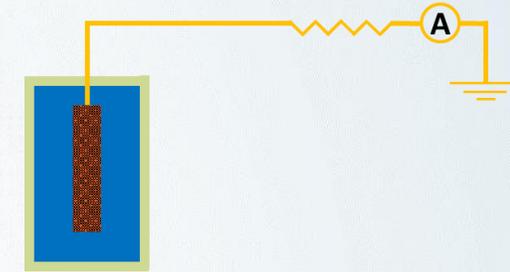
Material: **Grafted silica (C8)**
Liquid: **Water**



3. Preliminary results

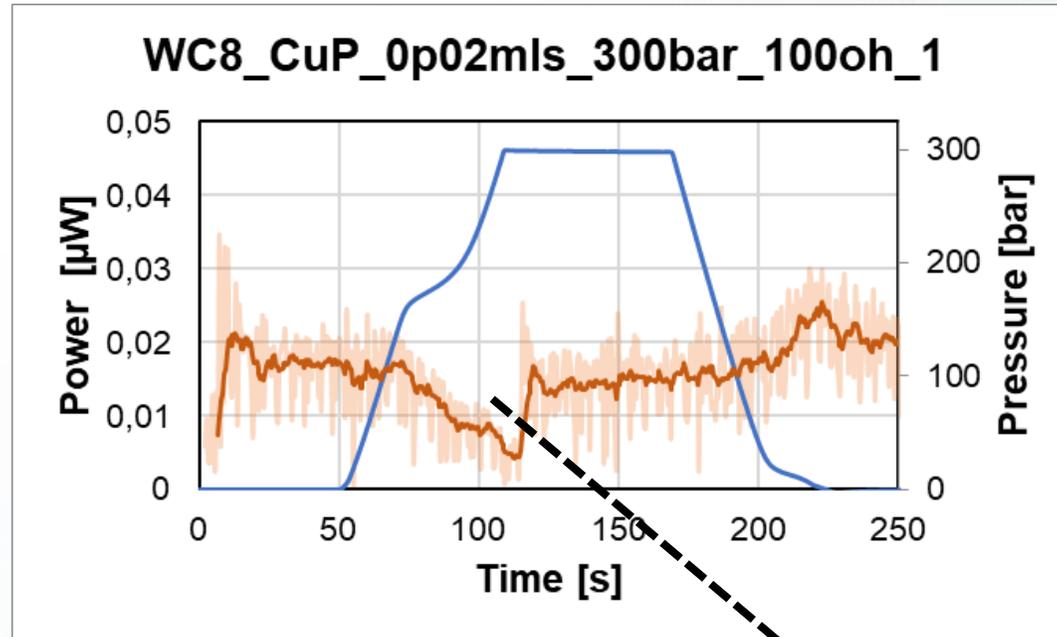


Single-electrode configuration: Results



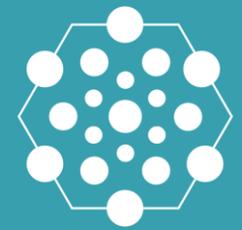
Intrusion

Extrusion



$E = 4,5 \mu\text{J/g}$

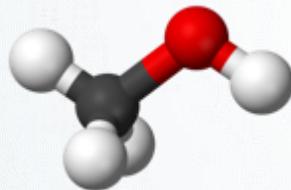
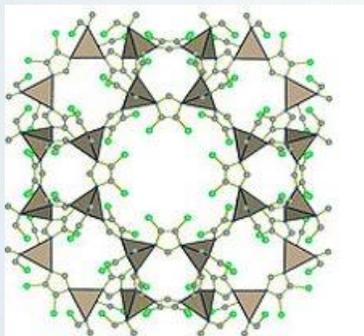
4. Conclusions



Challenges

▪ Materials & liquids:

- Grafting silicas
- MOFs
- Mixtures...



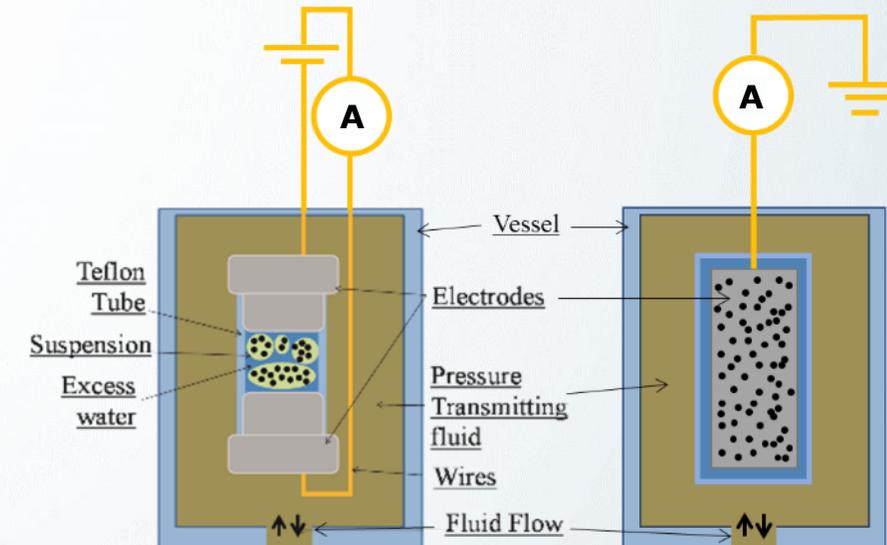
▪ Configuration:

- Electrode geometry
- Electrode material
- Isolation/Connections...

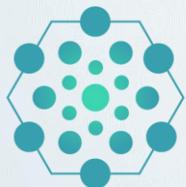


▪ Operation conditions:

- Int/ext rate
- Temperature...



Thanks for your attention!



ELECTRO
INTRUSION



CIC
energiGUNE

MEMBER OF BASQUE RESEARCH
& TECHNOLOGY ALLIANCE