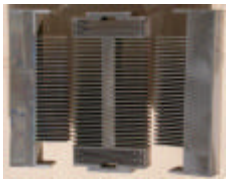
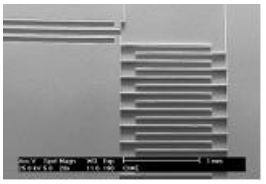
High Damping Electrostatic System For Vibration Energy Scavenging





G. Despesse, T. Jager, J.J. Chaillout, J.M. Léger, A. Vassilev (CEA-LETI)

S. Basrour, B.Charlot (TIMA)

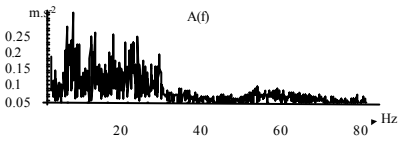
Introduction and objectives

Goal

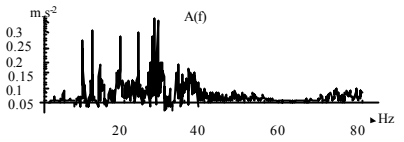
- To design an electrostatic micro-system able to scavenge energy from ambient mechanical vibrations.

Constraints

- Surrounding mechanical vibration frequencies are mainly and widely distributed below 100 Hz.



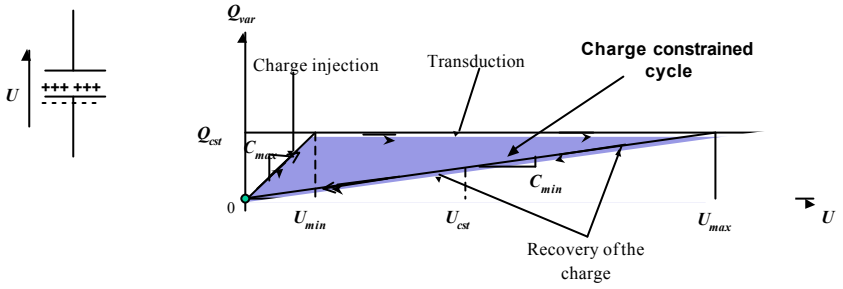
Car



Metallic stair

⇨ A large bandwidth electrostatic transduction system has been investigated to meet these requirements

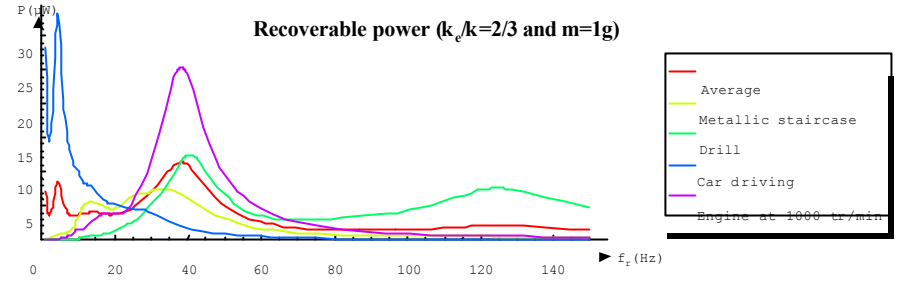
Electrostatic transduction : Principle

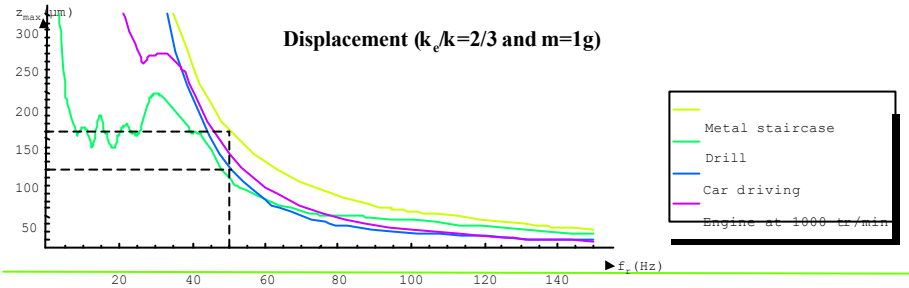


Energy scavenged :

$$E = \frac{1}{2} U_{\max} U_{\min} (C_{\max} - C_{\min})$$

Electrostatic transduction : Data-processing simulation



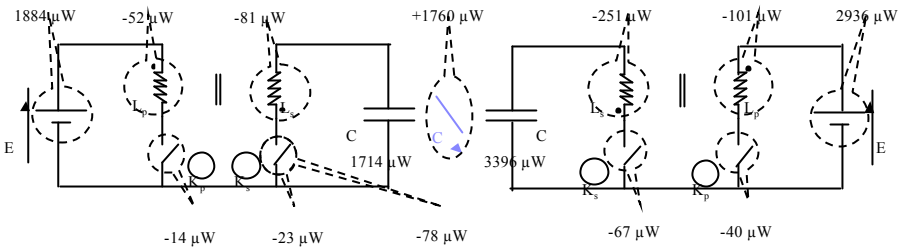


Prototypes : Final structure properties

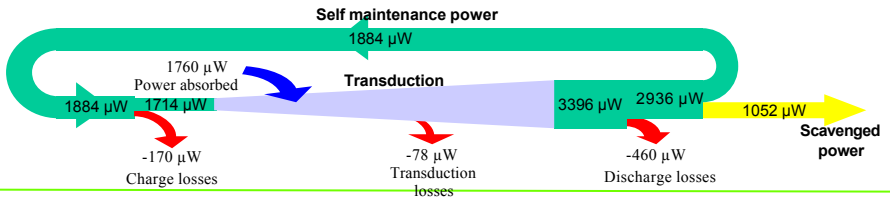
	Tungsten	Silicon
Mass (g)	100	2.1
Δ (µm)	116	100
$C_{relaxed}$ (pF)	900	14
U_{max} (V)	300	313
P_{max} (µW) @ 50 Hz	4600	70
Size (mm^3)	30*60*10	8*28*1

Power management : Power balance

Tungsten prototype excited at 50 Hz with a vibration amplitude of 90 µm



Efficiency = 60%



Thank you for your attention