A.D. 1308
unipg
DIPARTIMENTO
DI FISICA E GEOLOGIA

NiPS Laboratory
Noise in Physical Systems

Grafene applicato a sistemi di energy harvesting stampati in 3D

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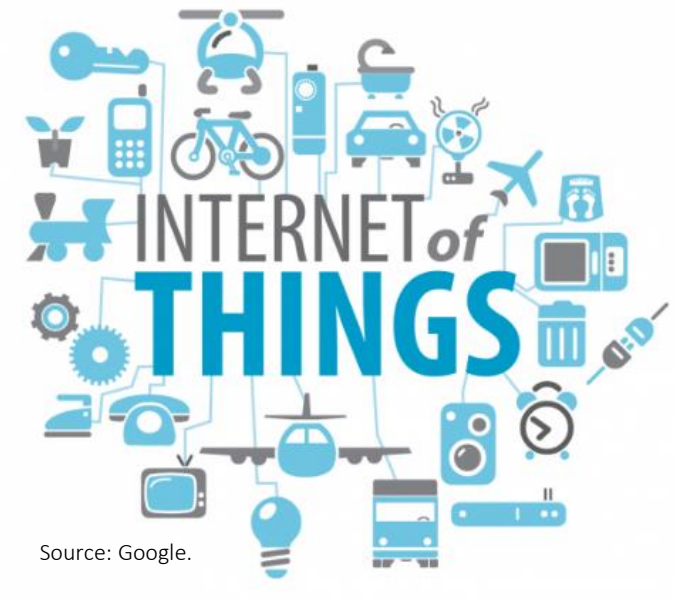
- Introduzione
- Energia da vibrazioni meccaniche
- Sistemi di energy harvesting basati su grafene stampati in 3D
- Conclusioni e prospettive future

Introduzione

Monitoraggio delle infratrutture con reti di sensori autonomi

Source: Perpetuum ltd



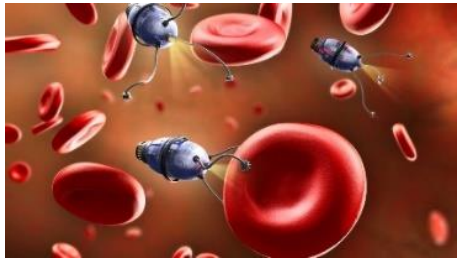
Source: Google.

Healthcare/Body monitoring

Source: Google.

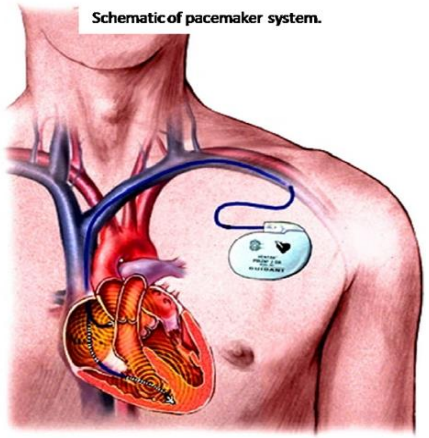
Micro/nano robots

A. Freitas Jr., Nanomedicine, Landes Bioscience, 1999



Nanorobot **0.1 - 10uW**.

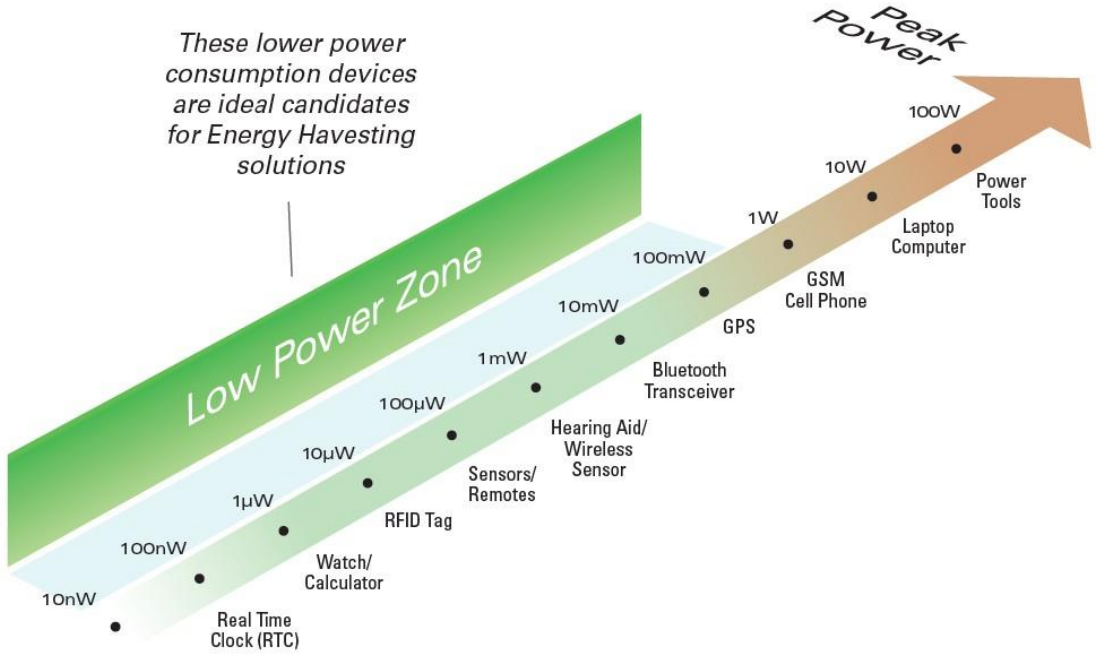
Pacemaker

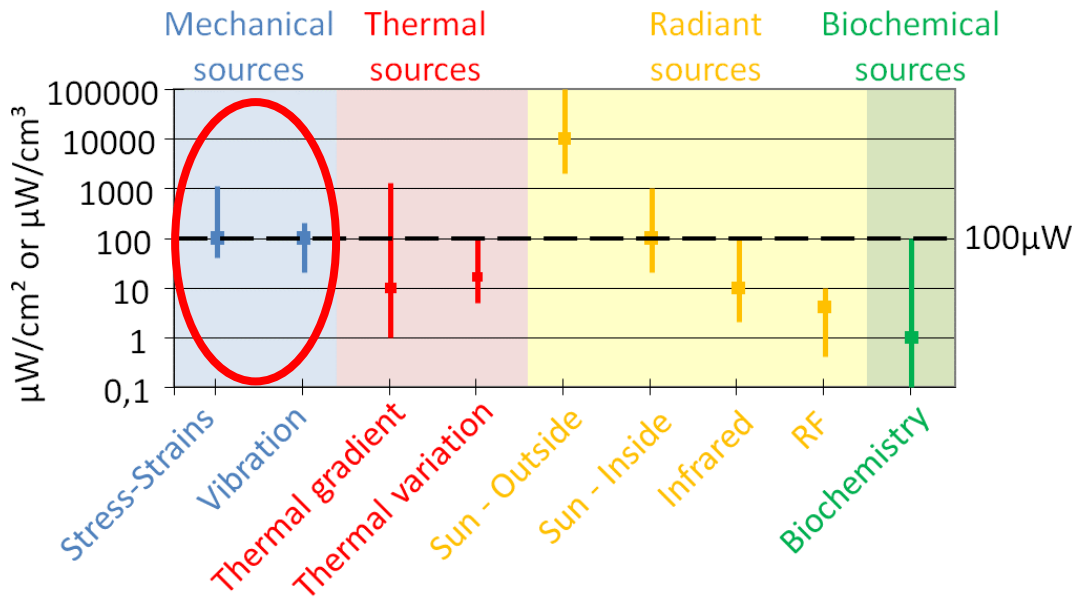


D. Tran, Stanford Univ. 2007

200uW da battito cardiaco

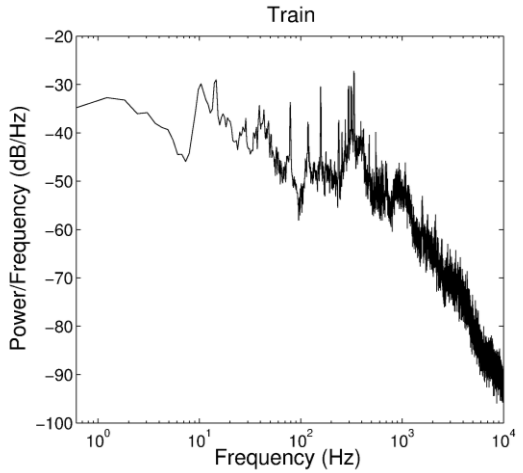
Introduzione

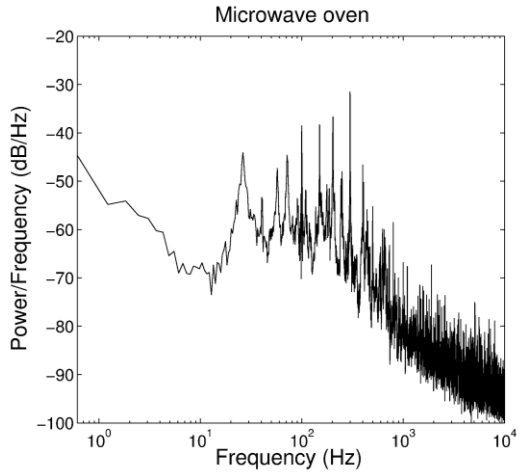




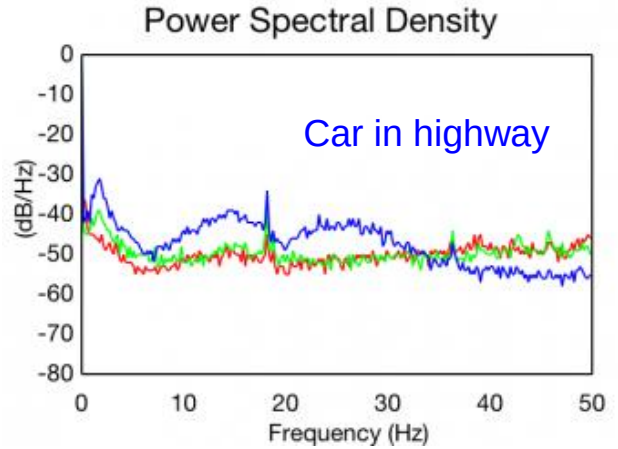
S. Boisseau et al. 2012

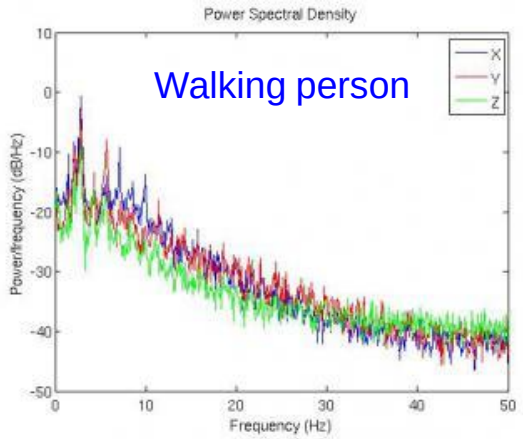
Energia da vibrazioni meccaniche



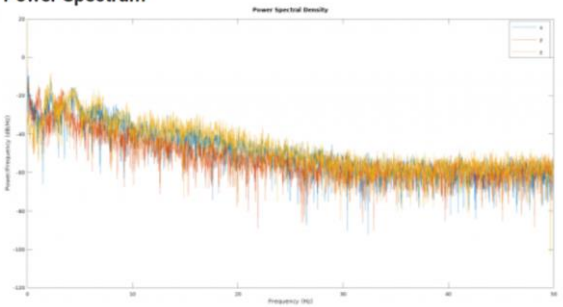


Cat walking





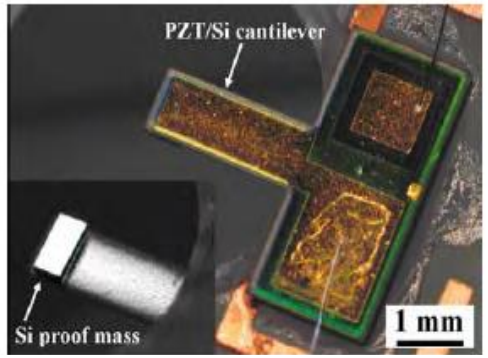
Power Spectrum



https://realvibrations.nipslab.org/

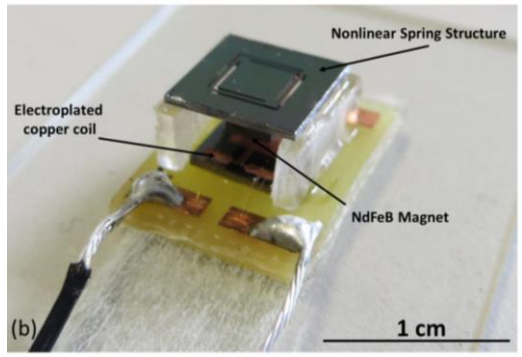
Sistemi di energy harvesting

Piezoelectric



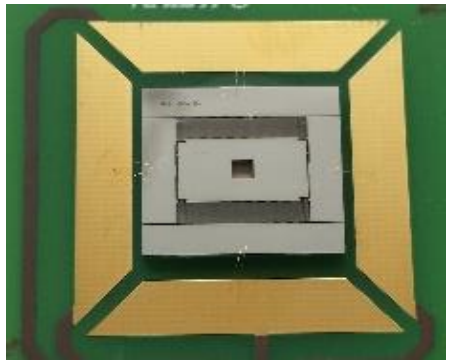
D. Briand, EPFL 2010

Magnetic induction



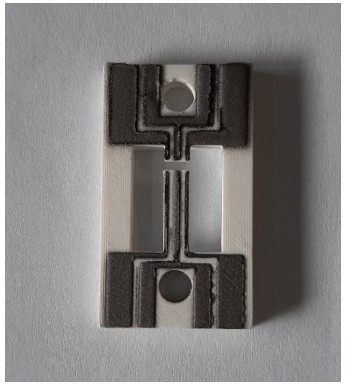
Mallick D. and Roy S., 2015

Electrostatic



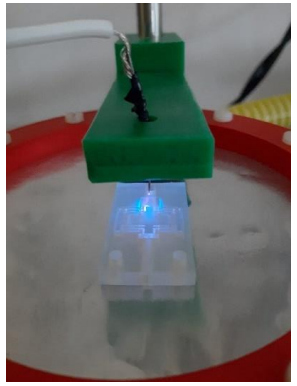
Cottone F., Basset P. 2013

3D printed generators



Electrostatic bi-stable energy harvester

Interdigitated capacitive sensor with PCL/copper nanotube charged filament

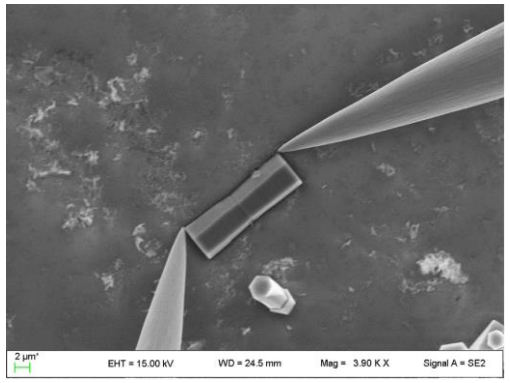


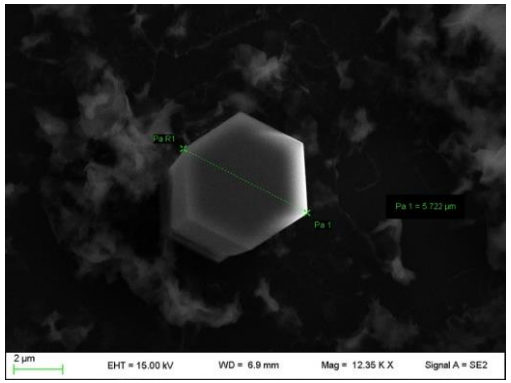
Corona discharge for electrets production

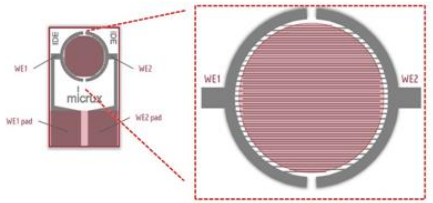
F. Cottone @ UNIPG

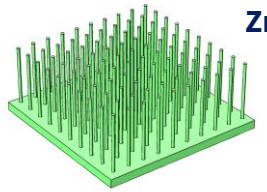
Sistemi di energy harvesting

- Micro generatori **elettrostatici** ad **elettreti**
- Micro genertori **piezoelettrici micro/nano strutturati** per energy harvesting









ZnO forest

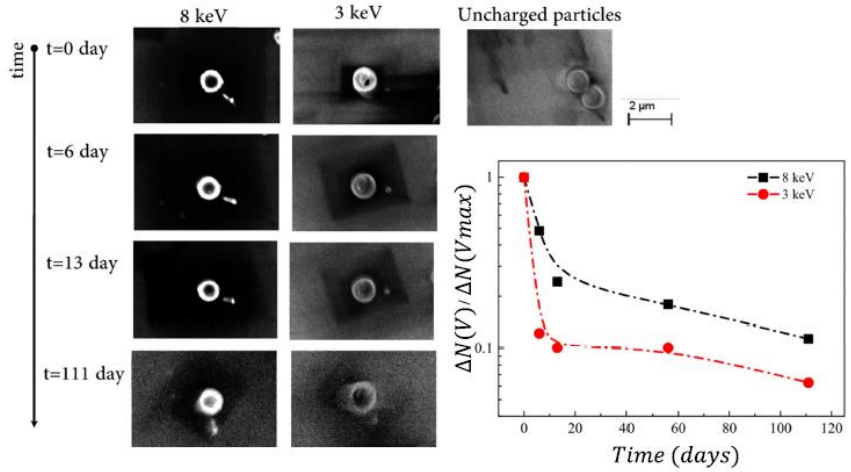


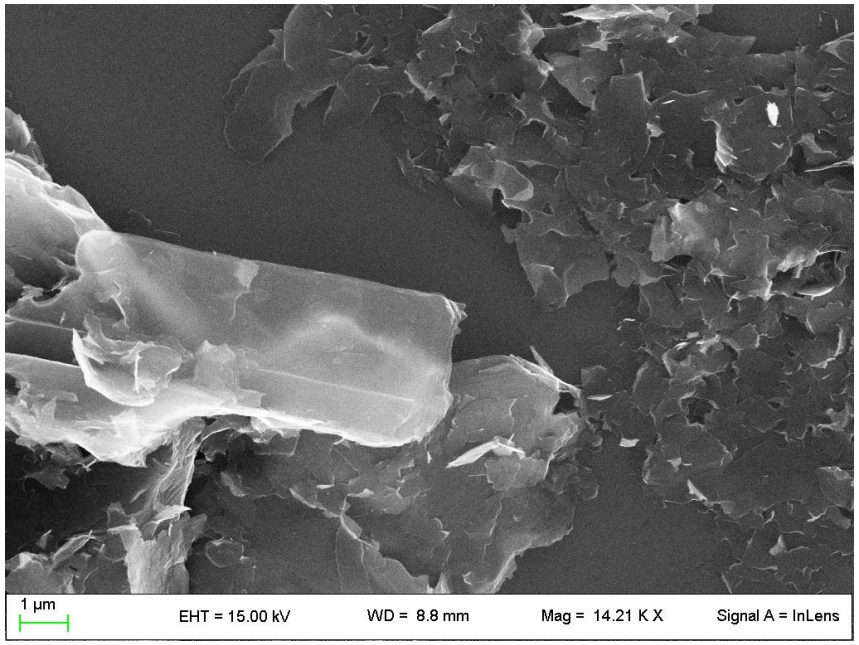
Figure 7. Images from the in-lens detector of the charged (first line, 8 keV and second line, 3 keV) and control particles (third line) at different times from the charging. In the graph: time behaviour of the emitted electrons difference between a charged and a non-charged particle.

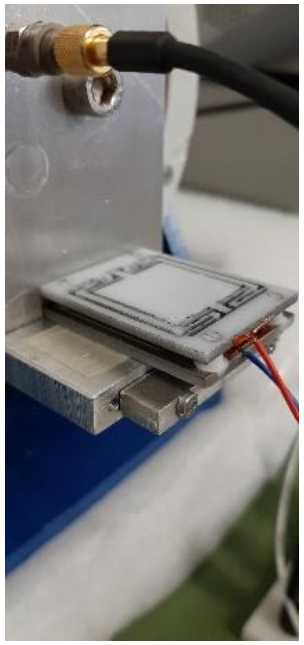
Bonacci, F., Di Michele, A., Caponi, S., Cottone, F., & Mattarelli, M. (2018). https://doi.org/10.1088/1361-665X/aaca55

Sistemi di energy harvesting

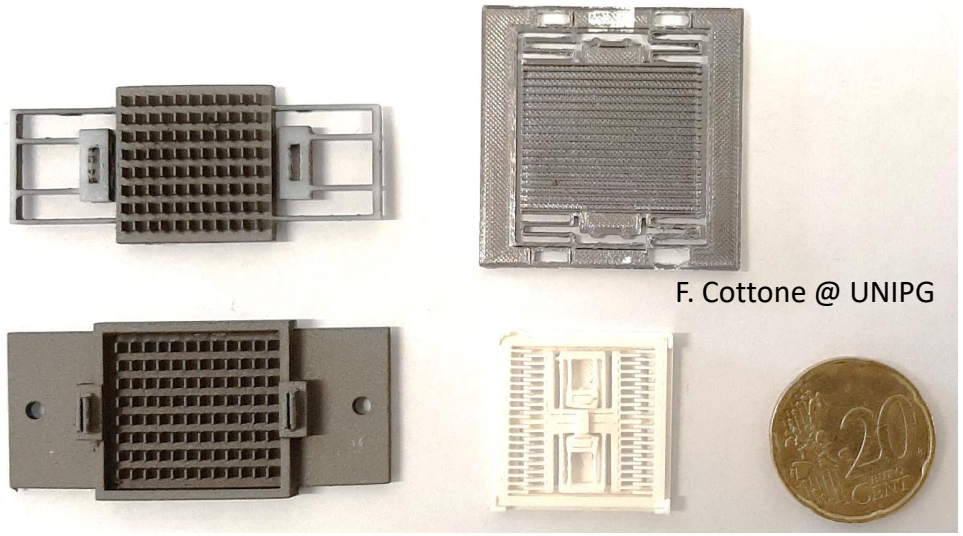
- Micro generatori elettrostatici **stampati in 3D**

Sintesi del grafene





A. Di Michele, F. Cottone - sintesi grafene



3D printed in-plane electrostatic energy harvester

3D printed Interdigitated capacitive harvester

Conclusioni e prospettive future

- L'utilizzo del **grafene** nei generatori elettrostatici per **energy harvesting** da vibrazioni presenta un notevole potenziale.

- I sistemi di **energy harvesting stampati in 3D** ed integrati con **grafene** sono una promettente alternativa **low-cost** ai sistemi MEMS basati su silicio

- La prospettiva di un parco scientifico e tecnologico con facilities per la sintesi/fabbricazione di **nanomateriali**, **micro** e **nano dispositivi** rappresenta una grande opportunità la ricerca e per il trasferimento tecnologico nel settore **dell'energy harvesting** con impatto verso l'industria **territoriale** e **nazionale**.

Jiang, Y (2018). https://doi.org/10.1002/adfm.201707024

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