Magnetic MEMS for Energy

Orphée CUGAT – G2Elab Grenoble, France

Introduction

This course will introduce the benefits of exploiting magnetism for MEMS, and illustrate applications of magnetic MEMS to the global field of Energy.

Contents

Part 1) how and why homothetic downscaling of magnetic systems are generally favourable to magnetic interactions, between magnets and/or conductors, as well as admissible current density. Integration of active elements into MEMS:

- conducting coils, permanent magnets & active materials.

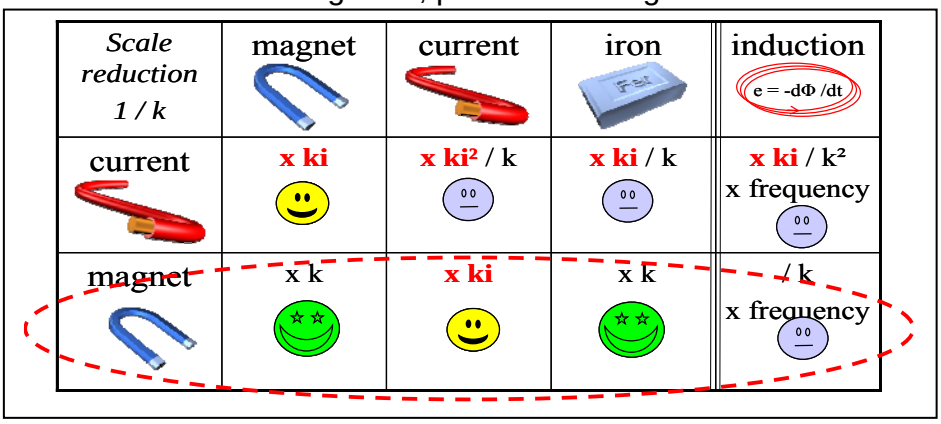

Figure 1: Effect of homothetic scale reduction on force density for various magnetic interactions

Part 2) several illustrated examples of application of Mag-MEMS to Energy:

- magnetic micro-actuators,
- micro-sources & harvesters of energy, exploiting magnetism,
- MEMS for energy network supervision.

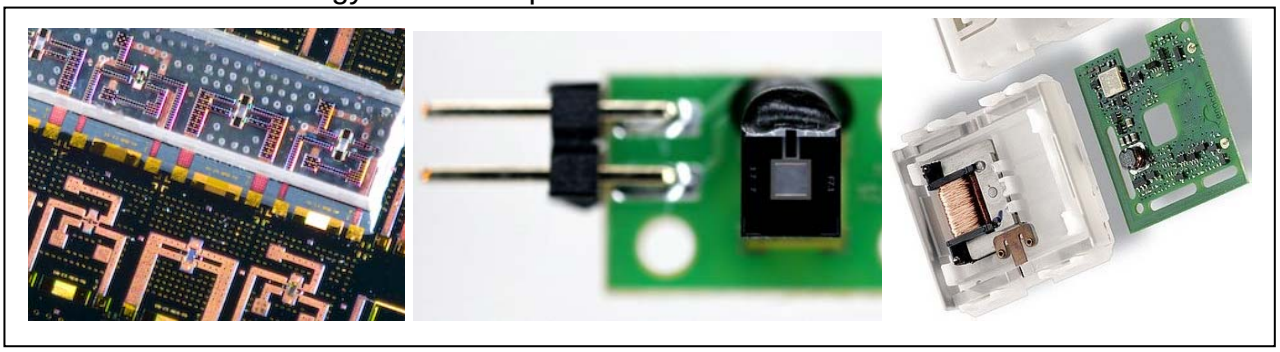

Fig 2: Left: Si-integrated bistable micro-switches (1 mm² each. G2ELab + CEA/LETI).
Centre: 2D Si-integrated scanner for pico-projectors (2x2 mm². LEMOPTIX)
Right: Energy harvester for autonomous remote switch (EnOcean)

Conclusions

1) Scale reduction laws are mostly beneficial to magnetic interactions in MEMS
2) Mag-MEMS offer high energy density actuation and/or electrical generation
3) Autonomous MEMS sensors can improve global Energy management

References

Scale reduction laws: Cugat et al IEEE Trans Mag 2003
Applications: conference proceedings Power-MEMS, Transducers, MEMS