

TOSHIYOSHI LAB.

[MEMS for Frugal Electronics Technology]

Center for Interdisciplinary Research on Micro-Nano Methods (CIRMM)

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Micromachine System Engineering (IIS), Micro Device Engineering (RCAST)

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Downscaling in size of microelectronics predicts a new era of distributed wireless sensor network, so-called the trillion-sensors of the Internet-of-Things (IoT) as a potential application of the More-than-More type electronics empowered by the vital added values of integrated micro electromechanical systems (MEMS). Besides the importance of sensors autonomous are indispensable Recent R&D on

MEMS for FRUGAL ELECTRONICS

energy sources elements.

Wireless Sensor ~100µW

Brain ~60W

Wrist Watch ~10µW

Physical

MEMS Energy Harvester Vibration-type ~1mW

Heart Beat

Diaphragm Motion

Base Metablism ~1500 kcal/day

Caloric Intake ~2200 kcal/day

Implantable MEMS Energy Harvesters 10 ~100 µW

Physical

10mW

Power

Consumption

Generation

2010 2020 2030

Olympic Games in Tokyo

In-quantity	Applications to
✓ Human	10 ⁹
✓ cars	10 ⁷ /year
✓ phones	10 ⁸ /year
✓ cards	10 ⁶ ~10 ⁷
✓ screws	???
✓ railroads	27000 km in Japan

H.Toshi 2016

MEMS energy harvesters (MEHs) are based on mainly three different principles including electromagnetic, piezoelectric, triboelectric, and electrostatic. Due to the potential compatibilities with the micro electronics, we have chosen the electrostatic inductive vibrational energy harvester based on the permanent electrical charge called "electret"