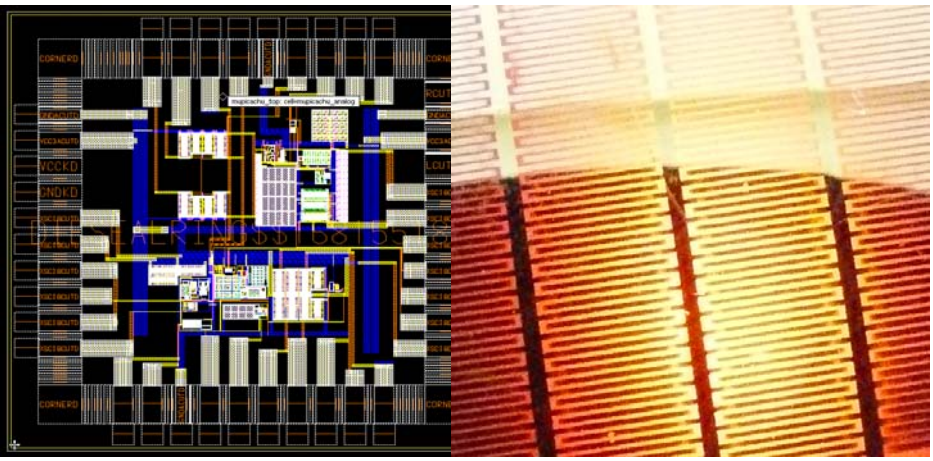

MICRO-THERMOELECTRIC PILES

Micro-thermoelectric generators for power low-power microelectronics

Project Summary

In the domain of renewable energies, powering mobile microelectronic devices by harvesting energy from the close environment is a very hot topic of R&D research programs. Harvesting wasted heat using motionless thermoelectric energy conversion systems is of a peculiar interest in terms of lifetime, robustness and volume.

However, since conventional thermoelectric modules are rigid, and based on expensive and toxic Bismuth Telluride compounds, they are actually limited to niche market applications.

This project aimed at producing a flexible, toxic-free, thermoelectric thermopile dedicated to the harvesting of weak heat source like the human body, taking advantage of three key developments:

1- Thermoelectric nanostructured composites made of environment-friendly materials, using advanced low-cost nanotechnology as a substitution technology to Bismuth Telluride.

2- High-density integration of thermocouples by advanced “shadow-mask” techniques, avoiding then the conventional complex, costly lithographic techniques.

3- Integration of a power management unit (PMU), able to practically power microelectronic devices from low-power heat sources to “standard” voltages.

The successful outcomes demonstrate that:

1- The so-obtained thermoelectric heat harvesters are within the range of 100μW under a temperature difference of 5°C. This benchmarking is the state-of-the-art requirement to power mobile microelectronic devices.

2- The integrated circuit designed in the 180nm TMSC process is able to up-convert to 2.7 V low-power sources starting from 0.3V. As soon as the thermoelectric module delivers up to 500mV the PMU yield achieves 48%.

Valorisation

These micro-piles are oriented to the powering of mobile microelectronics, and therefore propose a substitution technology to conventional chemical batteries. The first market aimed at is medical applications like earing-assistance or pacemakers. In a longer term, this technology aims at providing solutions to power mobile devices like mobile phones or hand wrist watches.

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