Silicon micro- nanotechnologies and compatible materials for the energy autonomy of small devices

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Abstract

Energy harvesting, tapping into environmentally available sources such as heat and vibrations, may be a good solution in man-made scenarios applications for the energy autonomy of devices in continuous monitoring scenarios and distributed intelligence schemes (Smart Everywhere, Internet of Things, Trillion Sensors). Furthermore, coupling those harvester devices to secondary batteries in order to buffer enough energy to account for the power peaks demanded by wireless communication of data could be a quite enabling energy autonomy solution.

The EU project SiNERGY focuses on silicon and silicon friendly materials and technologies to explore energy harvesting and storage concepts for powering microsensors nodes. Silicon technologies provide a promising path to miniaturization, 3D architectures, mass production with economy of scale, and the ability of power intelligence integration.

An exploding number of sensors makes small sensor size desirable, so that its microenergy supplier device is equally under a size downscale pressure. Energy harvesting sources tend to be low energy density sources, so capturing enough energy in such conditions demands architectures with high density features. Silicon micro and nanotechnologies offer the possibility of substrate micromachining, which produces not only free surfaces and volumes that can couple with the environment but also quasi 3D architectures with high aspect ratios, into which nanomaterials may be integrated if need be, thus enabling such internal high density features. Different approaches for thermal harvesters, mechanical harvesters and thin film/3D solid state batteries are considered within the project. Energy densities of 100μW/cm2 seem appropriate for many such applications. Examples of some of the proposed devices architectures and bottom-up or top-down nanomaterial integration will be shown and discussed.