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「社会構想マネジメントを先導する グローバルリーダー養成プログラム」

東京大学
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Innovative thermal energy harvesting for future autonomous applications

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As communicating autonomous systems market is booming, the role of energy harvesting will be a key enabler. As example, heat is one of the most abundant energy sources that can be converted into electricity in order to power circuits. Harvesting systems that use wasted heat open new ways to power autonomous sensors when the energy consumption is low, or to create systems of power generators when the conversion efficiency is high. The combination of different technologies (low power µ-processors, µ-batteries, radio, sensors…) with new energy harvesters compatible with large varieties of use-cases with allow to address this booming market. Thanks to the conjunction of ultra-low power electronic development, 3D technologies & Systems in Package approaches, the integration of autonomous sensors and electronics with ambient energy harvesting will be achievable. The applications are very wide, from environment and industrial sensors to medical portable applications, and the Internet of things may also represent in the future a several billions units market.

In this presentation, we will address an innovative way of harvesting heat, and present the fabrication of thin modules that work without a heat sink at temperatures close to ambient. The key point of the integration of this technology is the ability to keep a large thermal gradient on a device by intelligent control over the thermal flow. Then, to provide an innovative system of conversion of heat into electricity, the concept is based on two key principles: 1-the conversion of a continuous stream of heat into mechanical impulses, 2-the conversion of these mechanical pulses into stored electrical energy. The generated electric power density can be increased by miniaturizing each device, but an optimal working point should be found in order to have high power due to scaling and enough signal so as to overcome the threshold of the harvesting circuit. The concept is unique in the sense that it is based on a matrix structure of micro or mini energy nodes which will work together and which do not require the use of radiators, thanks to the controlled thermal resistance. This opens the door to new properties and features of the object, with better performance for low power applications.

主催：
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