Resumen de Tesis Doctoral

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola de Doctorat

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Título de la tesis	Ultra-low Power Circuits based on Tunnel FETs for Energy Harvesting Applications
Unidad estructural	
Programa	Doctoral Program in Electronic Engineering
Códigos UNESCO	330799 / 330719 / 330703 /

(Mínimo 1 y màximo 4, podéis verlos en http://doctorat.upc.edu/gestion-academica/carpeta-impresos/tesis-matricula-y-deposito/codigos-unesco)

Resumen de la tesis de 4000 caracteres máximo (si se superan los 4000 se cortará automáticamente)

There has been a tremendous evolution in integrated circuit technology in the past decades. With the scaling of complementary metal-oxide-semiconductor (CMOS) transistors, faster, less power consuming and more complex chips in less area have made possible electronic gadgets to evolve to what we see today.
The increasing demand in electronic portability imposes low power consumption as a key metric to analog and digital circuit design. While dynamic power consumption decreases quadratically with the decrease of power supply voltage, leakage power presents a limitation due to the inverse sub-threshold slope (SS). A power supply reduction implies a consequent threshold voltage reduction that, given the fixed SS, cause an exponential increase in leakage current. This poses a limitation in the reduction of power consumption that is inherent to the conventional thermionic emission transistors (MOSFETS and FinFETs). In thermionic emission-based transistors the SS at room temperature is limited to 60 mV/dec.
To circumvent the SS limitation of conventional transistors, devices with different carrier injection mechanisms are required. The Tunnel Field-Effect Transistor (TFET) is presented as the most promising post CMOS-technology due to its non-thermal carrier injection mechanism based on the Band-To-Band Tunneling (BTBT) effect. TFETs are known as steep slope devices (SS < 60 mV/dec at room temperature). Large current gain (ION/IOFF > 10^5) at low voltage operation (sub-0.25 V) and extremely low leakage current have already been demonstrated, placing TFETs as serious candidates for ultra-low power and energy efficient circuit applications. TFETs have been explored mostly in digital circuits and applications.
In this thesis, the use of TFETs is explored as an alternative technology also for ultra-low power and voltage conversion and management circuits, suited for weak energy harvesting (EH) sources. As TFETs are designed as reverse biased p-i-n diodes (different doping types in source/drain regions), the particular electrical characteristics under reverse bias conditions require changes in conventional circuit topologies. In this thesis rectifiers, charge pumps and power management circuits (PMC) are designed and analyzed with TFETs, evaluating their performance with the proposal of new topologies that extend the voltage and power range of operation compared to current technologies and circuit topologies. TFET-based PMCs for RF and DC EH sources are proposed and limitations (with solutions) of using TFETs in conventional inductor-based boost converters are identified.

Lugar: Barcelona Fecha: 29-Marzo-2017

Firma