Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website www-csc.utt.fr)

Supervisor's name :	CHAPUIS	Given names :	Pierre-Olivier
Status (prof., assistant prof., …) :	CNRS research fellow		
Laboratory :	Micro and nanoscale heat transfer (MiNT) group	Website address :	https://cethil.insa-lyon.fr/en/node/52 , http://polivier.cha
Institution :	CETHIL (Centre for Energy and Thermal Sciences of Lyon) - National Institute for Applied	Website address :	https://cethil.insa-lyon.fr/en

Scientific competence of the supervisor:

Nanoscale energy transfer and conversion; thermal-energy harvesting. Computational (transport of energy at the size of energy carriers) and experimental (AFM, resistive thermometry and infrared spectroscopy) physics and mechanical/electrical engineering.

Two major publications in the field proposed for the PhD :

1. Local heat dissipation and elasticity of suspended silicon nanowires revealed by dual scanning electron and thermal microscopies, J.M. Sojo-Gordillo, G. Gadea-Diez, D. Renahy, M. Salleras, C. Duque-Sierra, P. Vincent,
2. Heat dissipation in partially-perforated phononic nano-membranes with periodicities below 100 nm, A. Massoud, V. Lacatena, M. Haras, S. Monfray, J.-M. Bluet, P.-O. Chapuis, J.-F. Robillard, APL Materials 10, 051113

Website address of the personal page : http://polivier.chapuis.free.fr , https://cethil.insa-lyon.fr/fr/content/chapuis-

Supervisor's email : olivier.chapuis@insa-lyon.fr

Description of the research work proposed for a PhD ***Topic # (see list) :*** IV-1

Title : Heat dissipation at nanoscale and consequences on mechanical stress

Subject :

Hot spots are one of the main causes of limitations in micro and nanoelectronic devices, since they have impacts on performances (e.g. temperature limits the speed at which operations can be performed) and mechanical properties (e.g. cracks due to variation of temperature in a device can appear and lead to device destruction). Unfortunately, it is not easy to determine the temperature field below a nanometer-scale heat source. Indeed, heat transfer through conduction is mediated by heat diffusion at macroscopic scale (Fourier's law), but not at nanometer-scale: it is instead mediated by ballistic heat conduction, governed by the Boltzmann equation. This regime takes place when energy carriers (air molecules, electrons in metals, collective atomic vibrations called phonons in crystalline solids) move freely between domain boundaries and do not interact between each other through collisions in the volume (the mean free path islarger than the domain size). It is crucial to study the transition between the diffusive and the ballistic regimes, when energy carriers interact weakly with each other (few collisions) and with the domain boundaries. In addition, the impact of thermal boundaries at surfaces is critical in some microsystems since the surface-to-volume ratio becomes larger.
The goal of the PhD thesis is to analyze how ballistic heat dissipation can lead to a different types of strain than the

Keywords :

Nanoscale heat transfer; thermomechanical strain; ballistic heat conduction

Expected collaborations :

Institutions dealing with multiphysics and mechanical stress/strain relationships. Internal collaborations at CETHIL are also planned.

Background required from the applicant :

Mechanical or electrical engineering. Numerical simulations. Knowledge of the microscopic mechanisms/physics of heat transfer would be a plus.

Existence of a PDF file detailing the proposal ("yes" or "no") : yes

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