

TOP-SET
Un programme FONCER du CRSNG
Séminaire

Le mercredi 27 septembre 2017, 15h30
Des rafraîchissements seront servis dès 15h
Complexe de recherche avancée, pièce 233
Université d'Ottawa, 25, rue Templeton
Le séminaire se déroulera en anglais.

NSERC CREATE TOP-SET
Seminar

Wednesday, September 27, 2017, 3:30 p.m.
Refreshments to be served starting at 3 p.m.
Advanced Research Complex, room 233
University of Ottawa, 25 Templeton Street

Heat transfer and energy conversion using near-field thermal radiation

Dr. Raphael St-Gelais, McGill University

ABSTRACT: Thermal radiation between objects separated by sub-micron distances can overcome classical blackbody radiation by orders of magnitude, while being concentrated on a narrow frequency distribution. These unique characteristics could enable breakthrough energy conversion technologies. For example, modules in which a heat source evanescently radiates energy towards a specially tailored (i.e., low bandgap) photovoltaic cell are predicted to greatly outperform existing solid-state heat-to-electricity converters (e.g., thermoelectrics). I will review the physical principles behind heat transfer in this regime and discuss the exciting opportunity it allows for near-field thermophotovoltaic (NFTPV) electricity generation. I will present our recent work [1, 2] in which we used MEMS (micro-electromechanical systems) to achieve the first experimental demonstration of heat transfer in the regime required for NFTPV (i.e. sub-100 nm separation and large thermal gradient between parallel surfaces). I will also discuss the possibility of using hot-carrier internal photoemission effect to create silicon-based low-bandgap (0.5 eV) photovoltaic cells for NFTPV [3].

[1] Raphael St-Gelais, Linxiao Zhu, Shanhui Fan, and Michal Lipson, "Near-field radiative heat transfer between parallel structures in the deep sub-wavelength regime" *Nature Nanotechnology* 11, pp. 515–519 (2016)

[2] Raphael St-Gelais, Biswajeet Guha, Linxiao Zhu, Shanhui Fan, and Michal Lipson, "Demonstration of Strong Near-Field Radiative Heat Transfer between Integrated Nanostructures", *Nano Letters* 14 (12), pp. 6971-6975 (2014)

[3] Raphael St-Gelais, Gaurang. R. Bhatt, Linxiao Zhu, Shanhui Fan, and Michal Lipson, "Hot Carrier-Based Near-Field Thermophotovoltaic Energy Conversion," *ACS Nano* 11, no. 3, pp. 3001–3009 (2017)

BIO: Raphael St-Gelais will be joining the Department of Mechanical Engineering at the University of Ottawa in January 2018. His research program will focus on novel Opto-Thermo-Mechanical Microsystems for applications such as energy conversion, long wavelength photo-detection, and high precision force sensing. He is currently a postdoctoral researcher with Jack Sankey's Optomechanics lab in McGill University, where he studies the interplay of mechanics and near-field thermal radiation in high-Q mechanical resonators. From 2013 to 2016 he was a postdoctoral researcher with Prof. Michal Lipson's Nanophotonics Group at Cornell and Columbia Universities, where he worked on MEMS for near-field heat transfer control. He received the Alexander Graham Bell Canada Graduate Scholarship in 2009 for his Ph.D. work on Optical Sensors and MEMS-tunable optical components, as well as postdoctoral fellowships from FRQNT and NSERC for his work at Cornell & Columbia.



TOP-SET est un programme de formation FONCER du CRSNG en puissance optoélectronique ayant pour but de façonner une cohorte de personnel hautement qualifié détenant des connaissances approfondies en systèmes optoélectroniques pour rejoindre les rangs d'équipes de recherche et développement.

Pour de plus amples renseignements sur TOP-SET, veuillez contacter Christine Couture, sunlabadmin@uottawa.ca

NSERC CREATE Training in Optoelectronics for Power: from Science and Engineering to Technology (**TOP-SET**) is a training program to form a cohort of highly qualified personnel with comprehensive understanding of optoelectronic systems, capable of joining advanced R&D teams.

For further details regarding TOP-SET, please contact Christine Couture, sunlabadmin@uottawa.ca



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