

MSc Project in Electrical Engineering

Beginning: May 2018 or September 2018

Interdisciplinary Institute for Technological Innovation (3IT)
Department of Electrical and Computer Engineering
Université de Sherbrooke, Québec, Canada

Laboratory: Quantum Semiconductors and Photon-based BioNanotechnology
Site web: www.dubowski.ca

Project leader: Prof. Jan J. Dubowski, SPIE Fellow

Phone: (819) 821-8000 x. 62528

E-mail: jan.j.dubowski@usherbrooke.ca

Subject: **Digital Photo-Etching of III-V Semiconductors: Innovative Technology for Nanoscale Device Fabrication**

Project summary

The Quantum Semiconductors and Photon-based BioNanotechnology Laboratory of the **Interdisciplinary Institute for Technological Innovation (3IT)** has been involved in the fundamental and applied research of the interactions between lasers and functionalized surfaces of III-V quantum semiconductors (QS).¹ The interest in this research is driven by the continuous search of technological solutions offsetting the deficiency of current methods in the fabrication of advanced nanoscale photonic and electronic devices.

We have demonstrated that low-power laser excitation of electron-hole pairs in photoluminescence emitting GaAs/Al_{0.35}Ga_{0.65}As nano-heterostructures immersed in aqueous solution of NH₄OH allowed pulsed (cycled) etching of these materials, up to approximately 100 nm deep, with a sub-monolayer precision per cycle.² We expect that thicker nano-heterostructures could be etched in dedicated solutions – the process that still needs to be investigated (**Goal 1**). Our interest is also in nanostructuring of GaInP/GaAs and AlGaIn/GaN nano-heterostructures investigated for photovoltaics and high-electron mobility transistor devices (**Goal 2**).

The sub-monolayer depth etching precision offers the possibility of undertaking a fundamental research concerning the mechanisms of reorganization of self-assembled monolayers interfaced with digitally photo-etched materials. This topic (**Goal 3**) will be considered pending the outcome of the work towards Goals 1 and 2.

Required skills

We are looking for a physics or electrical engineering student with background in solid state and semiconductor physics. Ideal candidate should be highly motivated, enjoy hands-on experience, and demonstrate independent thinking leading a project to conclusion. The candidate will take advantage of working in the interdisciplinary environment of 3IT.

1. Dubowski, J. J.; Nazemi, E.; Aithal, S.; Huang, X., Photo-electrochemical sensing method using photoluminescence-emitting semiconductors. *Patent 2015, PCT/CA2015/050073 (allowed, to be issued in Summer 2018)*.

2. Aithal, S.; Liu, N.; Dubowski, J. J., Photocorrosion metrology of photoluminescence emitting GaAs/AlGaAs heterostructures. *J. Phys. D: Appl. Phys.* **2017**, *50*, 035106.

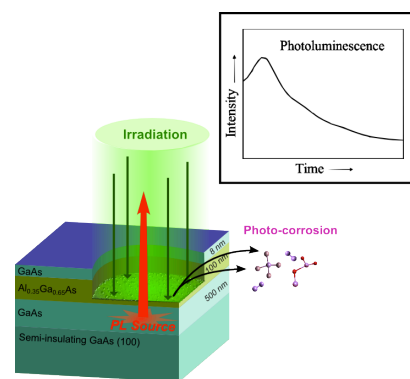


Fig. 1. Digital photo-etching of a GaAs/AlGaAs nano-heterostructure could be monitored *in situ* with the photoluminescence effect.²