Two PhD Positions available
International Collaboration in Plasma Microfluidics for Cancer Research

Cold atmospheric plasmas generate highly reactive chemistry at room temperature [1]. This plasma reactivity influences sensitive biological organisms and can be used in medical applications [2, 3]. Plasmas in cancer care have led to a reduction in tumor volume. However, the fundamental interaction processes of plasma with living organisms are still poorly understood.

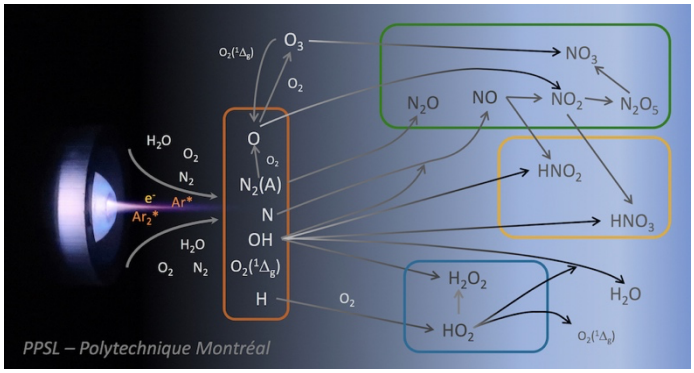

Figure 1: Plasma chemical pathways relevant in plasma medicine

The main goal of our collaborative project is to reveal the role of plasma reactive species in cancer treatment. You will be developing a novel microfluidic-based platform that links plasma to biomedical model systems via a flow-controlled chemistry.
You will work in an international collaborative project, with researchers from Polytechnique Montréal and McGill University, Canada and University of Antwerp, Belgium.
In the proposed platform, a tailored reactive species composition will be delivered to cancer cell layers and 3D spheroid tumor models in a microfluidic chip, allowing us to quantify the cellular response. You will investigate the kinetics and dynamics of key processes in plasma-liquid-bio systems.

In this controlled environment, the plasma-liquid chemistry will be analyzed through 0D/2D chemical modeling, benchmarked by diagnostics of plasma parameters and reactive species in gas and liquid phase. The chemical modelling will include a numerical representation of the microfluidic channels. Our approach will form a key milestone to replace current empirical plasma treatment by knowledge-based, targeted plasma therapy.

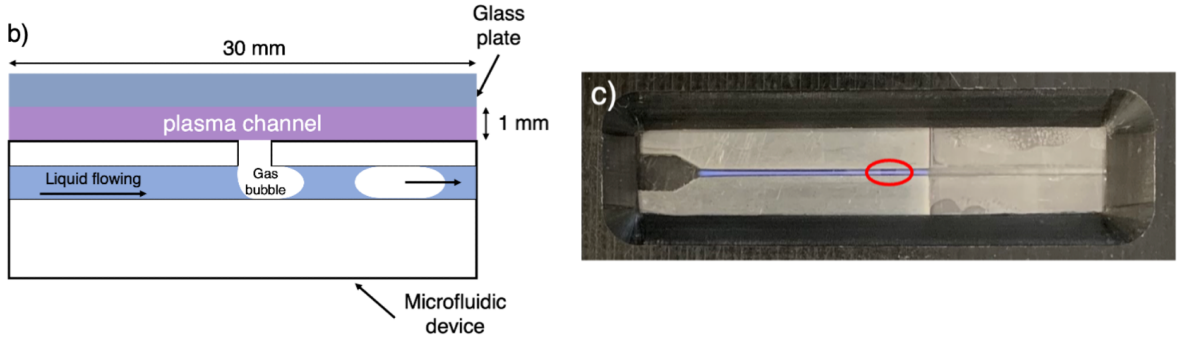

Figure 2: Schematics and demonstrator for the plasma-microfluidic platform.

Contact: Stephan.reuter@polymtl.ca

One or possibly two PhD positions are available to study plasma liquid interactions. Main activities will be :

- develop a platform linking plasma and microfluidics based on the work presented in [4, 5],
- develop and apply laser-based diagnostics of the plasma gas-phase,
- develop and apply liquid diagnostics,
- develop a microfluidic platform capable of studying plasma medical processes on 3D tumoroids and tumor model systems,
- interact with collaborators at University of Antwerp to link experiments and modelling.

One PhD position is available on plasma-cancer studies:

- develop and adapt a microfluidic platform to study the effect of plasma treated liquids on cancer inactivation,
- develop and apply biological analysis on cell signaling and plasma-induced apoptosis,
- develop and study combinatory approaches combining plasma and chemotherapeutics,
- interact with collaborators at University of Antwerp to link experiments and modelling.

You will work with an interdisciplinary team of:

Stephan Reuter (Professor in Engineering Physics, Polytechnique Montreal)
Daria Boffito (Professor in Chemical Engineering, Polytechnique Montreal)
Sylvain Coulombe (Professor in Chemical Engineering, McGill University)
Thomas Gervais (Professor in Engineering Physics, Polytechnique Montreal)
Derek Rosenzweig (Professor in Department of Experimental Surgery, Research Centre of McGill University Health Centre)

The project's international collaboration is with the PLASMANT team led by Professor Annemie Bogaerts at the University of Antwerp, Belgium. PLASMANT will provide a complex plasma chemical model with which the experimental results found in your thesis can be analyzed. Research visits to Belgium are planned.

We strive to foster integration and support for minorities of ethnic, gender, sexual orientation, religious belief, and social class and strongly encourage application from underrepresented groups. We are looking forward to your application with CV, relevant works, grades, and motivation letter (email contact below).

[1] Lu, X.-P., Reuter, S., Laroussi, M. and Liu, D. 2019 *Nonequilibrium Atmospheric Pressure Plasma Jets: Fundamentals, Diagnostics, and Medical Applications* (New York: CRC Press), 9780429053665

[2] Keidar, M. 2015 Plasma for cancer treatment *Plasma Sources Science and Technology* **24**

[3] Graves, D. B. 2012 The emerging role of reactive oxygen and nitrogen species in redox biology and some implications for plasma applications to medicine and biology *Journal of Physics D-Applied Physics* **45** 263001

[4] Bissonnette-Dulude, J., Coulombe, S., Gervais, T. and Reuter, S. 2023 Coupling the COST reference plasma jet to a microfluidic device: a new diagnostic tool for plasma-liquid interactions *Plasma Sources Science and Technology* **32** 055003

[5] Bissonnette-Dulude, J., Heirman, P., Coulombe, S., Bogaerts, A., Gervais, T. and Reuter, S. 2023 Coupling the COST reference plasma jet to a microfluidic device: a computational study *Plasma Sources Science and Technology*

Contact: Stephan.reuter@polymtl.ca