

Research Topic for the ParisTech/CSC PhD Program
(one page maximum)

***Field (cf. List of fields below): Physics**

Subfield: Applied Physics

Title: Pulsed cold plasmas interacting with liquids

ParisTech School: Ecole Polytechnique

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Short description of possible research topics for a PhD:

The objective of this thesis is the study of plasmas in water or at the gas / liquid interface. Possible applications of this fundamental work are applications of plasmas to nanomaterial synthesis, water treatment, medicine and agriculture.

This thesis will be mostly experimental and will have several aspects:

- i) Understand the physical mechanisms underlying the initiation and propagation of the discharge. This study will be based on rapid imaging and ombroscopy coupled with time-resolved emission spectroscopy to measure plasma parameters during the propagation of the "streamer" in water. Particular attention will be paid to the high pressure conditions (> 100 bar) observed during the first nanoseconds of penetration of the plasma filament into the liquid medium.
- ii) Study the plasmas generated in the gas phase at the liquid / gas interfaces. In particular, we want to develop plasmas of a few nanoseconds at high frequencies (10 kHz) and compare them to radiofrequency type plasmas.
- iii) Explore the biological and chemical potentialities of micro-discharges in aqueous media.

Required background of the student: Physics, Applied Physics, electrical engineering,

A list of 5(max.) representative publications of the group: (Related to the research topic)

- A1. **Non-thermal DBD plasma array on seed germination of different plant species**
Bo Liu, Bruno Honnorat, Hang Yang, Jaime Arancibia, Loic Rajjou and Antoine Rousseau
J. Phys. D: Appl. Phys. 52 (2019) 025401
- A2. **Charge and energy transferred from a plasma jet to liquid and dielectric surfaces**
M. Dang Van Sung Mussard, E. Foucher, A. Rousseau
J. Phys. D: Appl. Phys. (2015) 48 424003
- A3. **The influence of the geometry and electrical characteristics on the formation of the atmospheric pressure plasma jet**
A Sobota, O Guaitella and A Rousseau
Plasma Sources Sci. Technol. 2014 23 025016 doi:10.1088/0963-0252/23/2/025016
- A4. **Dynamics of plasma evolution in nanosecond underwater discharge**
Marinov, I; Starikovskaia, Svetlana; Rousseau, Antoine
J. Phys. D: Appl. Phys, 2014, 47 224017, (<http://iopscience.iop.org/0022-3727/47/22/224017>)
- A5. **Time-resolved imaging of nanosecond-pulsed micro-discharges in heptane.**
A. Hamdan, I. Marinov, A. Rousseau and T. Belmonte
J. Phys. D: Appl. Phys, 2014 47 055203 doi:10.1088/0022-3727/47/5/055203

1. transport