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THE FRENCH AEROSPACE LAB

PROPOSITION DE POST-DOCTORAT

Title : Plasma-assisted CO_2 valorisation with a novel micro-structured plasma reactor.

Référence : **PDOC-DPHY-2024-XX**

(à rappeler dans toute correspondance)

Contract Start date : march-july 2024	**Application deadline :** march 1st

Duration : 12 months – Net Salary : 25 k€ / year

Keywords

PLASMA, CO2, PROCESS INTENSIFICATION, ENERGY TRANSITION

Profil et compétences recherchées

We seek a postdoctoral candidate with a PhD in physics, plasma chemistry or chemical engineering (diploma obtained after 2021). The successful candidate should be creative, pro-active, able to work in a multidisciplinary context as a team player. Demonstrated experimental skills in either process intensification, non-equilibrium plasma or plasma-catalysis are required. In addition, the candidate should be proficient in oral English or French, with demonstrated communication skills. Applicants should send a CV to the contact persons listed below.

Project description

The valorization of Carbon dioxide (CO_2) is a one of the paths explored to reduce greenhouse gases emissions. **Plasma processes** have attracted considerable interests over the last decade because they can be tailored to enhance the reactivity of molecules even when operated at atmospheric pressure and temperature. The dissociation of CO_2 in carbon monoxide (CO) is an example of reaction where the plasma can be of interest compared to classical thermal processes (thermolyse), which require very high temperatures of operation. In general, atmospheric plasma processes can either achieve significant conversion fraction at lower efficiency (usually for dielectric barrier discharge), or high conversion efficiency at low conversion fraction (for glidearc discharge)[1, Fig. 24]. The key to achieve economically sustainable plasma process is of course to combine both a significant conversion fraction with a high efficiency. For this purpose, the type and the topology of the discharge is critical.

Recently, a joint research project between the plasma research group at ONERA and the plasma-catalysis research group at Institut Jean Le Rond d'Alembert has resulted in the patenting of a new type of plasma reactor using a microstructured topology, as shown in Fig. 1. Although not optimized for a specific process, this reactor has shown **very promising preliminary results**, in particular for the dissociation of CO_2. Following these findings, ONERA and d'Alembert seek first to confirm and expand these findings and second, to improve our understanding of the processes responsible for this efficiency. In particular, the role of the specific plasma regime used in the reactor, akin to a "cold" spark, needs to be carefully characterized.

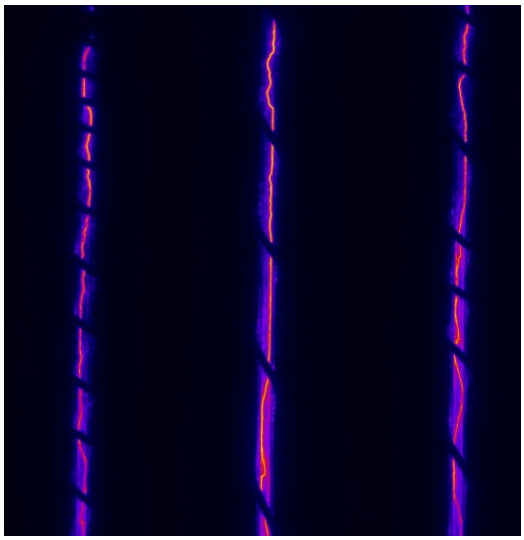

Fig. 1 : View of the filamentary discharge in the micro-structured reactor.

The goals of this postdoctoral project are:

- To **map the performances** of this new reactor design. For this purpose, the fellow will build from the existing experimental setup

to explore the parametric response of the reactor and find the conversion factor and efficiency.

- To **improve the reactor design** to facilitate its upscaling. For this purpose, the fellow will lead the design of an optimized reactor to demonstrate its operation on a larger scale
- To **investigate the driving mechanism** driving the efficiency in this particular reactor topology, using a model of the plasma kinetic that will be compared to the experimental measurements

The postdoctoral fellow will join a young team which includes at least two permanent staffs, another postdoctoral fellow and a PhD student. The fellow will develop skills related to atmospheric plasma generation and diagnostics, chemical analysis, experiment optimization and design. At least one publication detailing the performances of the reactor is expected, plus a contribution to an international conference.

[1] R. Snoeckx et A. Bogaerts, « Plasma technology – a novel solution for CO_2 conversion? », *Chem. Soc. Rev.*, vol. 46, nº 19, p. 5805-5863, 2017, doi: 10.1039/C6CS00066E.

[2] A. Bogaerts et G. Centi, « Plasma Technology for CO2 Conversion: A Personal Perspective on Prospects and Gaps », *Frontiers in Energy Research*, vol. 8, 2020, Consulté le: 29 août 2022. [En ligne]. Disponible sur: https://www.frontiersin.org/articles/10.3389/fenrg.2020.00111

External collaborations : Institut Jean Le Rond d'Alembert, Sorbonne Université, University of Saragossa

Hosting department at ONERA

Département : Physics, Instrumentation, Environment & Space Department (DPHY)

Location (centre ONERA) : Palaiseau

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