



Seeking PhD Candidate

Theoretical and experimental study of a high-pressure thermal plasma

Context and challenges

In the context of low-carbon electricity, plasma processing is paving the way to meet tomorrow's energy and environmental challenges. Plasmas allow a robust, flexible and controllable energy supply at very high temperature without direct CO₂ emissions, in a very wide range of operating conditions and temperatures that can exceed those encountered in traditional combustion processes. Additionally, plasma processing can improve conversion yields and reduce the negative environmental impacts of many industrial processes. As a recognized world-leader in this field, PERSEE (Procédés, Energies Renouvelables et Systèmes Energétiques) has been working for many years on the development of a **methane pyrolysis process** for the production of hydrogen and carbon black.

Academic-Industrial partnership

This *three-year* thesis work is part of an industrial partnership between the Mines-ParisTech (mines-paristech.eu) and Monolith Materials, San Carlos, CA office (monolithmaterials.com) The PhD candidate will maintain active engagement and communication with engineers and scientists from Monolith Materials. This work will be based in Nice, France, with occasional travel to San Carlos, CA (i.e., the San Francisco Bay Area within the United States)

Scientific objectives

The bulk of research on thermal plasmas has been carried out at atmospheric pressure, and few studies have been devoted to the effect of high pressure ($>>1$ atm). The main objective of this thesis work is related to the study of arc discharges at elevated pressure. The impact of pressure over a wide range of plasma gas compositions will be investigated. This work will generate novel data and insights, with emphasis on:

- primary arc characteristics: radius, temperature, current-voltage relationship, radiation
- electrode performance and erosion
- arc topology, dynamics and stability

Methodology

The thesis work will be a combination of theoretical and experimental efforts. Theoretically, it will rely on the development of channel arc models as well as more complex Magneto-Hydro-Dynamics (MHD) models. Experimentally, a plasma device will be designed, developed and tested, with data generated to inform and improve model capabilities.

Candidate requirements

MS in mechanical or chemical engineering with excellent written and verbal communication skills. Proficiency in both French and English.

Specific skills

Physics and General Mechanics, Fluid Mechanics, Heat Transfer, Electrical Theory. Knowledge in plasma physics desired. Previous experience and interest in experimental activities. General knowledge of SolidWorks. Proficiency in python/MATLAB.

Expected Start Date

January-March, 2021

Application materials

1. Unofficial Transcripts (GPA and coursework)
2. 3 recommendations
3. Resume/CV
4. Cover letter / Statement of purpose

To apply, please send all application materials to Pr. Laurent Fulcheri at the email address below

laurent.fulcheri@mines-paristech.fr