INTERNSHIP OFFER

Master 2 or 3rd year of engineering school

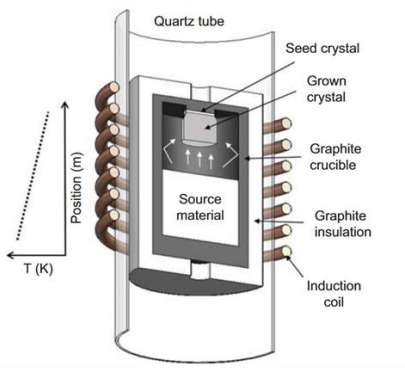
Evaluating the performance of carbon-fiber based insulations on different furnace designs with a modelling approach

Duration	6 months, starting ideally from february/march 2026
Location	Laboratoire SIMaP, 1340 Rue de la Piscine - BP 75 – 38402 Saint Martin d'Hères – France
Contacts	Yann GALLOU – Research Engineer at Mersen, detached at SIMaP yann.gallou@grenoble-inp.fr/yann.gallou@mersen.com Abdelmagid EL BAKALI – Research Engineer at SIMaP abdalmagid.el-bakali@grenoble-inp.fr

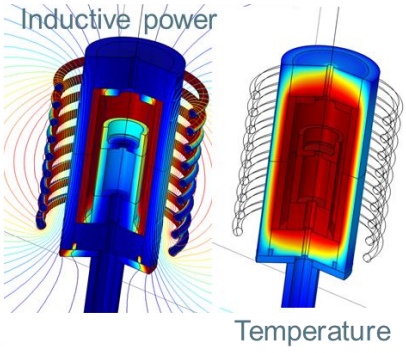
Context & objectives

Today, for ecological and geopolitical considerations, we need to reduce our dependence on fossil fuels. To achieve this, a massive electrification of society is envisioned in which power electronics components will play a key role. **Silicon carbide**'s exceptional properties make it an ideal material for the manufacture of these components, which however depend on the availability of large monocrystalline substrates of excellent quality. These substrates are fabricated from SiC boules grown by a **very high temperature (~2500°C)** process named PVT, for physical vapor transport. This process involves the inductive heating of a graphite crucible surrounded by a **carbon-fiber based thermal insulation**. These **insulations** obviously need to have a **low thermal conductivity**, to limit heat losses to the ambient, but they also require a **low electrical conductivity** to limit the interaction (coupling) with alternating magnetic field used for induction heating which would result in a degradation of the process performance. Their overall performance (temperature reached in the furnace VS power required) is then mainly dictated by these two properties. Mersen company can produce **insulations with varying electrical and thermal conductivities**. A certain insulation can then me more appropriate than another one, depending on the geometry of the furnace (crucible & felt's diameter, thicknesses…). Due to the variety of process geometries and needs, fabricating multiple insulation setups and evaluating their performance experimentally would be too expensive and time-consuming. **Modelling tools can be used instead**. The objective of the internship is to use such a tool (finite element commercial codes) to conduct parametric studies which will consist of **varying thermal and electrical conductivity of insulation felts on fictitious furnace geometries and identify the configuration that limits power consumption.** In addition, the effect of changes of thermal and electrical conductivities on the temperature profile in the furnace will also be assessed, since this governs the growth of SiC monocrystals.

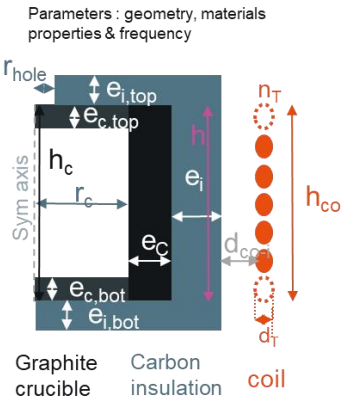
Typical PVT furnace



Finite element modelling



Parametric study



SIMaP/EPM - UMR 5266 CNRS - Grenoble INP – UGA
1340 Rue de la Piscine - BP 75 – 38402 Saint Martin d'Hères – France
Tél : +33 (0)4 76 82 52 01 - Fax : +33 (0)4 76 82 52 49 - Web : http://simap.grenoble-inp.fr

In practice the intern will be in charge of:

- Learning how to use a simulation tool (COMSOL) to solve induction and heat transfers phenomena involved in high temperature induction furnace.
- Setting-up reliable simulations by modelling a lab-scale PVT furnace, hosted in SIMaP.
- Use reverse engineering approach to retrieve thermal conductivity & resistivity values at high temperature.
- Conducting large parametric studies on various fictitious furnace geometries and analyze data and trends
- Reporting the results periodically

The internship will take place in the framework of a very dynamic and long-term collaboration between MERSEN company (https://www.mersen.com/fr) and SIMaP (https://simap.grenoble-inp.fr/), a research lab specialized in materials sciences and associated processes. It follows a 2-years research project, including 3 internships realized in 2024 and 2025.

Profile & requested skills

We are looking for a highly motivated student (M2 or 3rd year of engineering school) with a background in process engineering and/or thermal engineering and/or materials science and who is keen on learning and using simulation tools. The student must be dynamic, curious and autonomous. The student must speak French and/or English.