PhD position at the Materials and Structures Science Centre,
Georges Friedel Laboratory,
CNRS UMR 5307, Mines Saint-Étienne, France

Simulation of microwave-assisted sintering for pieces with complex shapes

Key-words: microwave sintering, microwave-diffusion interaction modeling, numerical simulation, finite element methodology, C++ programming.

Context: Sintering process is a step of powder metallurgy consisting in the densification of a pulverulent materials. This densification is achieved by thermo-activating diffusion mechanisms, while remaining below the melting point (solid state sintering). Usually, the powder is heated in a conventional furnace. However, several types of sintering processes have been developed during the last decades. Here, we are interested with the microwave-assisted sintering. The benefits are a better and faster densification, increasing the production rate and saving energy.

Objectives: The PhD thesis will take place in the LGF UMR laboratory at *École des Mines de Saint-Étienne*, and more specifically in the MPE (*Mechanics and direct Manufacturing Processes*) team. MPE has a strong experimental background in the ceramic microwave sintering, but also has developed numerical tools for simulating the matter flow by diffusion into a granular packing. However, the objective of the thesis is the simulation of microwave sintering at the macro- or process- scale, and not at the scale of the microstructure, in order to consider pieces with complex shapes. The scope of this work is the biomedical engineering (dental), shielding or structured surfaces.
Concretely, the PhD student will develop a C++ finite element code coupling

- the solid mechanics equations (elastoviscoplastic constitutive law with a phenomenological description of the densification, characterized by experiment).
- The heat equation,
- The Maxwell's equations (solved by a dedicated code).

The results obtained will be confronted to experiment. It should also be noted that a stay abroad for a period of three months, maximum, must be carried out (in one go).

Applicant profile: Candidate should have completed a Master in computational mechanics or related disciplines. The applicant should demonstrate both theoretical and computational skills (in continuum mechanics, finite element methodology, oriented-object programming are expected).

Administrative aspects: The PhD is funded for 36 months, starting in Fall 2017, with a net salary of 1600 €/month. The teaching activity of the PhD student will be of 40 hours/years (in English or French).

Contact: please send your application with a detailed CV to: bruchon@emse.fr