Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website www-csc.utt.fr)

Supervisor's name : Boutaous | Given names : M'hamed

Status (prof., assistant prof., …) : Professor

Laboratory : CETHIL - UMR 5008 | Website address : https://cethil.insa-lyon.fr

Institution : INSA Lyon , Mechanical Engineering Department | Website address : https://gm.insa-lyon.fr/fr

Scientific competence of the supervisor:

My activities aim to better understand the physical phenomena related to the processing of polymers and composites, in order to model the thermo-mechanical behavior of the material and its final characteristics. They include both experimental and theoretical approaches (modeling and simulation). My research topics are guided by enregy and heat transfer, multiphysics couplings, mainly thermomechanical and rheological lows governing these materials and processes at different scales, but also by the complex interaction between the processes, the structure and the material behavior.

Two major publications in the field proposed for the PhD :

1. L. Xin, M. Boutaous, S. Xin, D. Siginer, Multiphysical modeling of the heating phase in the polymer powder bed fusion process, Additive Manufacturing, Vol. 18, pp. 121-135, (2017),
2. P. Jafari Fisharaki, M Boutaous, S. Xin; Numerical and Experimental Study of Polymers Microwaves Heating. Key Engineering Materials, Vol. 926, (2022)

Website address of the personal page : https://cethil.insa-lyon.fr/fr/content/fluides-polymeres-et-composites

Supervisor's email : mhamed.boutaous@insa-lyon.fr

Description of the research work proposed for a PhD ***Topic # (see list) :*** IV. Science of mat

Title : Numerical modeling and analysis of microwave heating of polymers

Subject :

In order to advance the reactive extrusion process applied to polymers, we propose replacing traditional electric heating with microwave heating. This technique could offer the dual advantage of efficiently heating the material in the bulk and improving polymer's reaction kinetics.
Before ultimately considering the design of processing tools operating entirely under microwaves, this thesis aims first to equip an existing batch process with microwave technology, with the primary objective of melting a polymer in granule or powder form as quickly as possible in the chosen process. To achieve this, it is essential to understand the physics of microwave interaction with the material, first in the solid state if the material is granules or polymer powder, and then to model it. In a second phase, using already molten polymer systems, microwave coupling will be considered to efficiently activate chemical reactions and modify polymer materials. The objective at reserach work will be to be able to model the microwave-polymmer interaction, theheating of a set of solid granular polymer during processing and to establish a link between chosen heating rate, polymerization kinetics, and the characteristics of the microwaves in a controlled condition. Numerical and experimental approaches are involved.

Keywords :

Polymers, Microwaves, wave and material interaction, rhéology, heat transfer, modeling and simulation, dielectric materials and characteristics.

Expected collaborations :

collaboration with Microwave campany and The Polymer Materials Engineering Laboratory (IMP, UMR CNRS 5223) https://imp-umr5223.cnrs.fr/the-lab/introducing-the-unit/?lang=en

Background required from the applicant :

The candidate should have confirmed skills in numerical modelling, polymer materials, rheology, heat transfer, good skills in numerical handling of differential equations (finite elements), and a passion for experimental measurements.

Existence of a PDF file detailing the proposal ("yes" or "no") : Yes

(see guidelines on the website www-csc.utt.fr)