Projet de thèse Q42025-Q32028

Exploring the Fracture Resistance of High-Performance Ceramics Under Thermal Shock

Saint-Gobain, a global market leader in materials for construction and industry, develops advanced ceramic solutions for demanding sectors such as metallurgy and glassmaking. These ceramics are designed to withstand extreme temperatures (often exceeding 1000°C), corrosion, and mechanical stress. A key research focus is improving their resistance to cracking under thermal shock—crucial for performance and durability in harsh environments.

At the **Saint-Gobain Research Provence** centre in Cavaillon, existing experimental setups investigate fracture behaviour and thermal shock in refractory ceramics. Ongoing developments aim to refine control over thermal gradients and to study thermal fatigue under rapid, repeated heating cycles.

This research is part of a collaboration with the **LaMCoS** and **MATEIS** laboratories, both joint research units of **CNRS and INSA Lyon**. These laboratories conduct research on structures, materials, and dynamic systems using advanced experimental and numerical approaches, addressing both industrial and academic challenges.

The thesis project is situated at the intersection of materials science, thermo-mechanics, and numerical modelling—offering a unique opportunity to contribute to cutting-edge ceramic research within both industrial and academic environments.

To better understand how ceramics respond to extreme thermal conditions, this PhD project proposes a **hybrid experimental–numerical approach**.

On the **experimental side**, the study will explore **laser pulse heating** as a means to rapidly and precisely induce thermal shock in ceramic components—whether pristine or pre-cracked. By carefully controlling where and how heat is applied, it becomes possible to investigate how cracks initiate and propagate. Given the rigidity and brittleness of ceramics, the project will also involve developing a high-resolution monitoring system using tools such as **thermal imaging** and **digital image correlation**, enabling real-time tracking of crack formation and deformation.

On the **numerical side**, the project will implement **thermomechanical simulations** to model the stress and fracture behaviour observed in experiments. Techniques such as **coupled criterion** and **phase-field methods** will be adapted to the ceramics under study, allowing detailed predictions of crack evolution based on geometry and laser-induced thermal loads.

A strong feedback loop between simulation and experiment is expected to refine testing protocols, validate models, and ultimately improve the prediction of **thermal fracture resistance** across a range of industrial applications.

This CIFRE PhD position is offered within the framework of the joint laboratory MATILDE, a collaboration between Saint-Gobain, the MATEIS laboratory, and the LaMCoS laboratory.

Candidate Requirements:
Engineering degree in physics/mechanics/materials, interest in experimental thermomechanics, aptitude for numerical simulation, and effective communication with industrial partners.

Location: Villeurbanne (69) with occasional trips to Cavaillon (84)

To apply, send your application including a CV and a motivation letter by email with the subject line: "MATILDE Thermal Shock" to the addresses below or by submitting the application through the website of Saint Gobain.

Link: https://joinus.saint-gobain.com/en/fra/red/th/53570/264418/these-etude-experimentale-et-numerique-de-la-fissuration-de-pieces

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