# Open PhD Position in Materials Science and Engineering

## THErmal shock resistance of reFRActory ceramics, MICrostructure design and MICromechanical behaviour (THEFRAMIC )

## What is THEFRAMIC and what is the focus of this research project?

**THEFRAMIC** is a **multi-partner project** involving both research laboratories and industrial companies which aims to **optimize the microstructure design of ceramics.** Facing the challenges of energy efficiency and $CO_2$ reduction, THEFRAMIC offers an innovative approach combining **advanced characterization** and **predictive modelling** to develop a new generation of refractory materials in sectors such as **steel**, **cement** or **aeronautics**. Magnesia/spinel and magnesia/hercynite multiphase materials exhibit unique characteristics due to complex matrix/aggregate interfaces. Indeed, the role of controlled **multi-scale microcracking** in the microstructure is of interest in the objective of **improving thermal shock resistance**. THEFRAMIC is based on complementary research topics: **fine characterizations** by Electron BackScattered Diffraction (**EBSD**), **high temperature *in situ* characterization** (advanced synchrotron X-ray diffraction and **digital image correlation techniques**), macroscopic characterization of **thermomechanical properties,** and **multi-scale modelling** integrating discrete element simulations combined with **artificial intelligence algorithms** to predict the life of refractory materials in service conditions. THEFRAMIC is closely linked to the French-Austrian ANR project called NanOX-ML, for Nanostructure evolution in Oxide materials at high temperature investigated with advanced X-ray scattering and Machine Learning based data analysis, and offers a unique opportunity to work in academic and industrial environments.

## Recruitment of PhD student (f/m) within THEFRAMIC project

### PhD-2. Relationship between thermomechanical behaviour and multi-scale microcracking of magnesia-based matrix refractory materials

**Objectives:** Investigation of different magnesia based refractory materials and other composites, mechanical characterization of microstructure and thermomechanical properties using original experimental techniques: Resonant Frequency Damping Analyser (RFDA) to accurately measure elastic properties (Young's modulus, Poisson ratio), ATHORNA device using digital image correlation in order to understand thermal shock resistance and provide reliable data for digital models, acoustic emission during heating and cooling of ceramics to detect the damage.

**Qualification of the candidate**: **Master degree or an equivalent diploma** in materials science, materials engineering, condensed matter physics, solid-state mechanic or other closely related fields. She/he will get an ability to work independently, to plan and carry out intricate tasks. She/he will have to be part of a large multidisciplinary and international research group. Basic knowledge on mechanical behaviour of ceramics is mandatory. Additional experiences on the experimental approaches for thermal measurement by infrared camera and strain fields by Digital Image Correlation would be also appreciated. Excellent communication skills (both written and oral) in English are required.

**Applicant Profile:** The PhD student will be employed by Limoges University in France and will be located both in IRCER laboratory in Limoges and Pprime Institute in Poitiers. This position will be available from October 2025 and is offered on a fixed-term 36 months contract. The gross monthly salary will be equal to 2300 €.

## Apply until 2025, June 2nd

**Conditions of application:** the application, consisting of a detailed scientific CV, a letter of motivation, and a support letter, should be sent to the following addresses:

**Prof. Marc HUGER,** marc.huger@unilim.fr **Dr. Nicolas TESSIER-DOYEN,** nicolas.tessier-doyen@unilim.fr
**Dr. Jean-Christophe DUPRÉ,** jean-christophe.dupre@univ-poitiers.fr