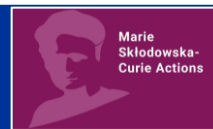




Open PhD Position in European Industrial Doctoral Network (DN-ID)



www.cesaref.eu

Concerted European action on Sustainable Applications of REfractories (CESAREF)

What is CESAREF and what is the focus of this network?

CESAREF will train researchers in multi-engineering areas and expose them to the academic and non-academic sectors through international and inter-sectoral mobility combined with an innovation-oriented mind-set. They will get the right combination of research-related and transferable competences in the **full production-to-the-end-of-life cycle of refractory materials applied to Iron & Steelmaking processes** with regards to the new operation conditions requested by the drastic reduction of greenhouse gas emissions, improved energy efficiency, and by life cycle assessment requirements. An important part of the project will be dedicated to the sustainability of refractories, including recycling issues, using the **Life Cycle Assessment** methodology. **15 doctoral candidates** will take advantage of the most sophisticated numerical tools and laboratory equipment to model, design and predict the life of refractory materials in critical operational conditions. Being trained in scientific, technical, and soft skills, these PhDs are the next generation of highly employable scientists and engineers in the refractory sector and related areas. New testing methods and models will be developed to address the Scientific/Technological challenges for these applications and help to design better performing and sustainable refractory materials and linings. The research training is implemented through strong relationships between 10 academia and 16 industrial partners across the EU. The CESAREF network (www.cesaref.eu) is structured to take full advantage of intensive cooperation between **academia, raw material suppliers, refractory suppliers and high-tech metal component producers** with a direct link to the FIRE federation (fire-refractory.org).

Specific subject of PhD7 (one of 15 PhD's of the CESAREF DN-ID project)

PhD7 Topic: Microstructure dependence of local strain through in-situ micromechanical investigations

Objectives: The thermo-mechanical behaviour of refractory materials is largely dependent on the material's microstructure, including morphology evolution, microcrack network and liquid formation arising during thermal loading. During this PhD, we will investigate the thermal behavior of these materials by measuring thermal-shock resistance and by using scale transition approaches. This work will be largely based on recipe design of refractory materials at Elkem (Norway), x-ray scattering and diffraction analyses at synchrotron radiation facilities, and additional electron microscopy observations. Micromechanical modelling aiming at linking the fine scale (nano/micrometers) with the 'engineer scale' (mm) will be also carried out.

Expected Results: Better understanding of complex strain and stress field installed within heterogeneous microstructures after the firing step of refractory materials. Analyze the results in relation with local thermomechanical properties of the involved crystals and the crack network. Establishing a set of rules for better design of refractory microstructure that can sustain huge thermal shocks in industrial applications.

Keywords: spherical particles, thermal-shock resistance, stress field, synchrotron radiation, micromechanical analysis, modelling, damage

Applicant Profile: *Master's level in Materials Science, Materials Engineering, Mechanics of Materials.* Candidates should be excellent in their skills for advanced experimental work, material physics and mechanics, oral and written communication skills (English). Ease with a programming language will be appreciated.

PhD main locations:

Period 1 - ELKEM (www.elkem.com), Kristiansand, Norway (18 months)

Period 2 - PIMM - Arts & Métiers (pimm.artsetmetiers.fr), Paris, France (18 months)

Due to the Mobility Rule by the funding agency, residents of Norway cannot apply for this PhD7 position

Apply until June 27th following indications at www.cesaref.eu/recruitment-procedure

If you have any questions, feel free to contact the supervisors:

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This project has received funding from the European Union's Horizon Europe research and innovation program under grant agreement no.101072625