Postdoctoral position: Precipitation evolution in heat-affected zone of low-alloyed C-Mn steel / precipitation modeling / microstructures-mechanical properties link

With 1,900 employees of 29 different nationalities, EDF R&D's main missions are to help improve the performance of the Group's operating units, and to identify and prepare medium and long-term growth drivers.

R&D mobilizes its energy experts to address customer issues. To do so, it can draw on more than 70 of the world's most modern, high-performance test, measurement and simulation platforms, in all areas of the energy sector.

The position is a 12-month postdoctoral contract part of the joint laboratory between Lyon University (INSA de Lyon), EDF R&D and FRAMATOME. The aim of this joint laboratory is to conduct high-level industrial research in the fields of simulation and welding metallurgy in order to guarantee the success of future nuclear construction projects.

Job description

This 12-month postdoctoral contract will be carried out mainly on the INSA campus site in Lyon France, and the postdoctoral researcher will travel periodically to the EDF Lab Les Renardières site in Paris area, to interact with the different stakeholders.

This postdoctoral position is focused on the study of precipitation evolution in heat-affected zone (HAZ) of low-alloyed C-Mn steel used in piping components of the main secondary circuit of pressurized water reactors (PWRs). During the circuit welding, welding operations followed by stress-relieving heat treatment (SRT) lead to microstructural gradients and consequently to variations in mechanical properties in the HAZ.

Regarding the stringent mechanical properties requirements of these components, it is essential to understand and be able to predict microstructural changes that occur in HAZ according to the steel chemical composition. The link between microstructural characterization and mechanical properties (impact test) will allow to determine the microstructural parameters that govern these properties, in order to propose optimization tracks concerning chemical composition, welding and SRT conditions.

In this study, numerical simulation, by modeling the precipitation kinetics, and experimental characterizations of an industrial material will be used. The simulation is based on PreciSo precipitation modeling software developed by the MATEIS laboratory (INSA Lyon). The experimental part will include thermo-mechanical cycling using Gleeble® simulator to obtain microstructures representative of those occurring in HAZ, stress-relieving heat treatment, microstructural characterizations at different scales (MO, SEM and TEM) and impact tests on these cycled specimens. The correlation between characterized microstructures and obtained simulations will improve precipitation model.

Activities

- Tests on Gleeble® thermomechanical simulator
- Heat treatment (SRT)
- Metallographic preparation (cutting, coating, and polishing)
- Microstructural characterizations (MO, SEM and TEM)
- Impact tests
- MatCalc® thermodynamic simulations
- Precipitation modeling (PreciSo)
- Additional analysis(s) if necessary.

Profile required : PhD in materials science ideally in metallurgy
Skills required : autonomy, rigour, initiative taking, teamwork and interest for experimental work
Duration : 12 months (as soon as possible)
Location : Univ. Lyon - INSA Lyon - MATEIS - UMR CNRS 5510
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