Industrial Research Chair in Forming Technologies of High Strength Alloys (CM2P)

ÉTS
Engineering for Industry
École de technologie supérieure

Presentation

High-strength alloys are commonly used to manufacture critical parts for the transportation, energy-production, and mining industries (including, for example, turbine drive shafts, wind-turbine gears, stabilizers for drilling rigs, and cutter shafts for the mining sector). The service properties of these alloys are very sensitive to the primary forming operations (i.e. ingot casting) as well as to the secondary forming operations such as forging and quench & temper heat treatment.

The interactions between the large number of alloying elements, characteristic of these alloys, and the multiple thermomechanical processing parameters such as time, temperature, strain and strain rate have a strong influence on the evolution of the microstructure and hence the final properties of manufactured parts. These complex interactions make it difficult to obtain targeted properties in a systematic manner. From an industrial standpoint, this difficulty results in more conservative design, higher nonconformity rates, and shorter life cycles for manufactured components. These problems are further enhanced when new processes or higher performance alloys are developed.

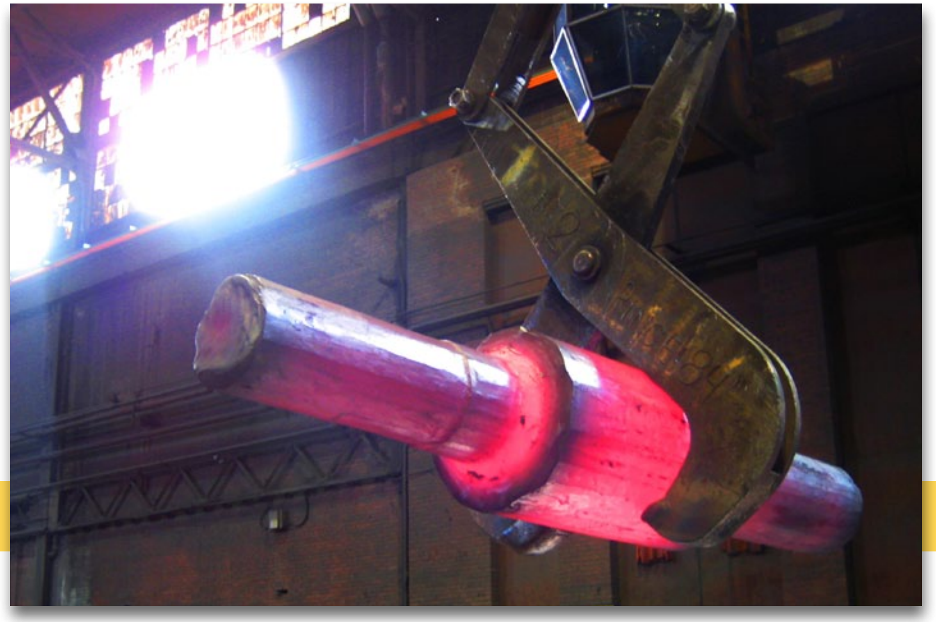
The team at the Industrial Research Chair in Forming Technologies of High Strength Alloys (CM2P) will study this industrial challenge in a comprehensive manner by using a micro-macro and multiscale approach and by considering the influence of manufacturing parameters on microstructure evolution and the resulting impact on service properties.

The Chair's activities will revolve around two main research objectives:

- To understand the influence of manufacturing parameters at high temperature and develop models to simulate conditions encountered in industrial practice.
- To identify the micromechanisms responsible for the evolution of mechanical properties of manufactured parts under industrial working conditions.

Benefits

- Optimization of current manufacturing processes, development of new alloys and new thermomechanical processes using high temperature deformation testing with a view to mapping microstructure evolution in the investigated materials.
  - Determination of the kinetics of phase transformation; static, dynamic, and metadynamic recrystallization, precipitation kinetics of secondary phases (before and after phase transformation).
  - Study of the influence of the strain path and crystalline texture on behaviour during the manufacturing process.
- Development of reliable methods enabling realistic prediction of mechanical behaviour during the various stages of the manufacturing process.
  - Identification of micro-mechanisms responsible for the presence of microstructural heterogeneity which result in the deterioration of mechanical properties.
  - Development of simulation tools in order to accurately predict the occurrence of microstructural heterogeneities based on thermodynamics and kinetics studies.
  - Development of constitutive equations to predict microstructure evolution to predict and control the macroscopic behaviour.
  - Development and industrial application of reliable and realistic simulation models for forging and heat treatments processes.



Chairholder

Mohammad Jahazi is a professor in the Mechanical Engineering Department at École de technologie supérieure. For over 25 years, his research has focused on the forming and thermomechanical processing of metals, particularly high strength alloys used in the transportation and energy-production industries.

Professor Jahazi is particularly interested in studying the evolution of the microstructure and related micro-mechanisms that influence service properties. He has authored and co-authored over 180 publications, conference papers, and technical reports. He regularly provides expert consulting services to industry. He also frequently acts as external examiner for theses, and as reviewer for scientific articles, and grant applications.

Principal Partner

SOREL FORGE

Sorel Forge, the CM2P Chair's principal partner, is the country's leading manufacturer of high-strength forged steel. The company's ingot-casting, forging, and thermal processing capacities are unique in Canada. As a result of its leading expertise, the company has the potential to produce other high value-added alloys that can be used in the aerospace and energy-production industries.

Sorel Forge employs more than 350 people and is located in the Sorel-Tracy industrial cluster that is also home to major industrial players such as QIT, Arcelor-Mittal, and Alstom Énergie. The Sorel Forge-ÉTS Industrial Chair clearly exhibits the company's intention to raise its technological level, train highly qualified experts, and implement state-of-the-art analysis and prediction tools within the earliest stages of its production process in order to enhance its competitiveness and consolidate its world-class leadership position.

Mohammad Jahazi

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