Development of new alloys as alternative materials to the Cu-Be alloys

Research Projects in Metallurgy

SCIENTIFIC PROJECT: Alternative alloy to Cu-Be.

Cu-Be are a class of copper alloys with very high mechanical properties. They were discovered 80 years ago and are widely used in micro-mechanical industrial applications in Switzerland and in the world. These alloys are especially appreciated for combining very high strength and formability with an adapted heat treatment. These alloys can be elongated up to 70% strain after annealing and an ageing for a few hours can increase the yield strength by a factor 6 up to 1200 MPa. Despite these properties, the Cu-Be is doomed to disappear as Be is toxic and progressively forbidden in some fields. The project aims at developing alternative alloys to Cu-Be for mechanical applications.

The project focuses mainly on Cu-Ti alloys. They represent the most promising alternative to Cu-Be and have not been yet intensively studied. Like Cu-Be standard alloys, they are age-hardenable alloys with a nanometric precipitation (Figure 1) and they can be heavily deformed when the titanium is in solid solution (Figure 2). Model alloys have been casted specifically for this study and need extensive characterisation.

STUDENT PROGRAMS:

Student semester projects or thesis can be build depending on the student will on the following listed thematic:

- Carbon replicas elaboration to investigate the precipitation.
- Effect of a predeformation the precipitation.

Figure 1: TEM micrographs showing the nanometric precipitation of Ti in Cu-Ti alloys.

Figure 2: Highly deformed Cu-Ti alloy and EBSD characterization.
Effect of the quench temperature on the precipitation.
Effect of the casting temperature on macro-segregations
Study of the precipitation by measuring the conductivity
Effect of the composition and heat treatment on the tribology of Cu-Ti
Solid-works modelling of a Bourdon tube.

THE STUDENTS WILL BE ASKED TO:

- Do a literature review.
- Design of an experimental plan to answer a problematic.
- Carry out a significant experimental work: such as heat treatments, hardness tests, cold rolling, Scanning electron microscopy, Transmission electron Microscopy or Gleeble.
- Discuss the results with a critical approach.
- Write a report or the draft of a scientific article.
- Work in Teamwork and present orally the results obtained.

WORKING LOCATION: LMTM-EPFL at Microcity in Neuchatel

The students will be working full time in the laboratory LMTM led by professor Roland Logé, at Microcity in Neuchatel. Microcity regroups several laboratories in the field of Metallurgy (LMTM), Photovoltaic and Micro/Nano-technology, where the LMTM is expert in thermomechanical behaviour and additive manufacturing. Situated 45 minutes from Lausanne, Neuchatel is a town of 34 000 habitants with an active student life, where you can enjoy a large lake and a beautiful view on the Alps.

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