2nd International Workshop on Software Solutions for Integrated Computational Materials Engineering

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Sandbox Scenario 2

Production of a semi-finished rolled Aluminum sheet product

Introduction

Several structural and outer body components made of aluminum are produced via flat rolling process chains. The semi-finished product is a sheet metal that has to fulfill defined requirements and standards according to an industry or a region (e.g. US, EU, automotive or aerospace industry). These properties are typically engineering quantities as the ultimate tensile strength or the minimum bending angle. It is often necessary to take into account more than one processing step to guarantee these product properties for a semi-finished product.

Process route for the material

Subsequent rolling and heat treatment processes change the state of the material, which means the physical states within the material incorporating dislocation density, solution state or grain size, Figure 1. A physical state then will result in a set of engineering properties.

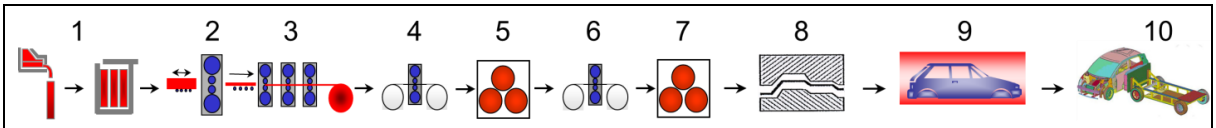

Figure 1: Process Chain for aluminum rolled products. 1) Casting and homogenization 2) Breakdown rolling 3) Tandem rolling and coiling 4) Cold rolling 5) Inter annealing 6) Cold rolling and skin pass rolling 7) Solution heat treatment (for age-hardening alloys) and natural ageing 8) Forming 9) Artificial ageing (for age-hardening alloys) 10) In service properties (crash, corrosion, cyclic loading).

It is quite evident that this leads to different perspectives onto the same process chain. The scope of the Sandbox scenario is to identify the input and output data that is needed to sufficiently describe an aluminum rolling chain and if such data can be derived from virtual experiments, ab initio or other

methods in the field of integrated computational materials engineering (ICME). Another aspect is to determine which data can or has to transported or modified throughout the chain incorporating through process modelling (TPM).

To bridge scales (e.g. macro to micro or vice versa) homogenization or localization has to be performed. This can lead to a change in the type of discretization for a property.

To realize the above-mentioned modelling ideas, namely ICME and TPM in this workshop an alloy independent structure for the input and output data has to be matched with a keyword list that is to be defined as standard by the ICMEg.

Particular attention shall be paid to:

- Which engineering quantities are necessary to model each processing step and how can they be derived from microstructural properties?
- Which microstructural features are to be taken into account to fully describe each processing step?
- How can homogenization and localization be performed in a single processing step and along the process chain?
- Are there solutions to handle the data and calculation time throughout the chain (industrial usability versus scientific research)?