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Predicting recrystallization phenomena with DIGIMU® during hot-rolling of grade AISI 304L

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Customers are more and more demanding for fine and homogeneous grain sizes in hot-rolled bars and wire rods dedicated to technical applications such as aeronautics, medical or watch-making. To assess those requirements, UGITECH is interested in using recrystallization models to better understand and predict the effects of both process parameters (like temperature, strain and strain rate) and metallurgical characteristics (chemical analysis, phase transformations, ⋯) on product microstructure evolution throughout its whole hot-rolling route. In this context, DIGIMU® software, developed by TRANSVALOR, has been tested in the case of stainless steel AISI 304L.
Firstly, material input parameters of DIGIMU® model related to grade AISI 304L (strain hardening, recovery, grain growth, dynamic and post-dynamic parameters) were identified through several series of laboratory hot-torsion tests carried out for various temperature (between 1000 and 1250°C), strain (up to 2) and strain rate (between 0,1 and 10s-1) ranges.
DIGIMU model® was then used to predict microstructural evolutions during hot-processing of AISI 304L stainless steel in the following conditions:
- Laboratory single pass hot-rolling with different re-heating temperatures and roughing rates.
- Industrial multi-pass hot-rolling focused on UGITECH roughing mill stands.
In each case, DIGIMU® results have been compared to experimental ones in terms of microstructure topology, recrystallized fraction and grain size distribution. Lab hot-rolling conditions with fast cooling rates were proned to generate different microstructures, from the onset of new grain nucleation up to complete recrystallization. Microstructure evolutions were shown to be well predicted by the full-field model.
Finally, local solute-drag effect (based on Cahn's approach) was integrated into the model to improve the consistency between experimental and predicted grain sizes, in both laboratory and industrial hot-rolling conditions.

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