

metal JOINing

K-Projekt Network of Excellence for Metal JOINing

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: K-Projects

COMET subproject, duration and type of project:

M2 - Ultra high strength welds, 09/2014 – 08/2018, multi-firm

Facilitation of development of high strength welds

A high amount of samples is necessary for development of new welding consumables to reach the requirements regarding mechanical properties and chemistry. In scope of the development of alform 1100-MC MatCalc calculations are used. Furthermore, investigations of the microstructure were made via atom probe and EBSD to understand the effect of micro alloying elements. The calculated results are in accordance with the results obtained by experiments.



Role of micro alloying elements

Few hundreds ppm of e.g. Al, Ti can be considered as an alternative concept compared to the conventional solid solution hardening. These micro alloying elements influence solidification and grain growth. Furthermore, they can form precipitates which may result in a strengthening effect.

In order to understand the influence of different micro alloying elements more detailed, the influence of different elements on the precipitation behaviour in the weld metal was evaluated. To reduce the experimental effort, thermodynamic and kinetic simulations were performed via MatCalc beforehand.



Example: Influence of Al on strength

Simulations of the yield strength showed that with the addition of Al resulted in a slightly lower yield strength compared to the reference alloy.

With augmenting N content increasing precipitation strengthening takes place, which results in an increase of the yield strength.

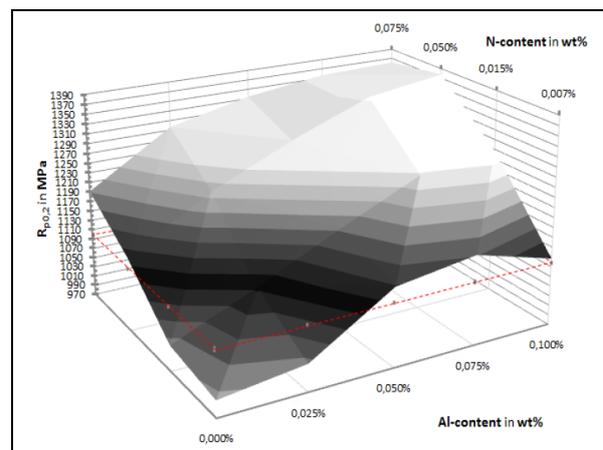
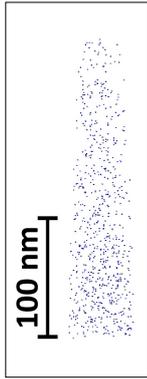


Fig. 1: Simulated yield strength depending on Al and N content. The red dotted line corresponds to the target value of 1100MPa.



This result was confirmed by the investigation via atom probe. In Fig. 2 a regular distribution of the Al atoms can be seen, which does not contribute to strength.

Fig. 2: Atom probe image of regular contribution of Al atoms

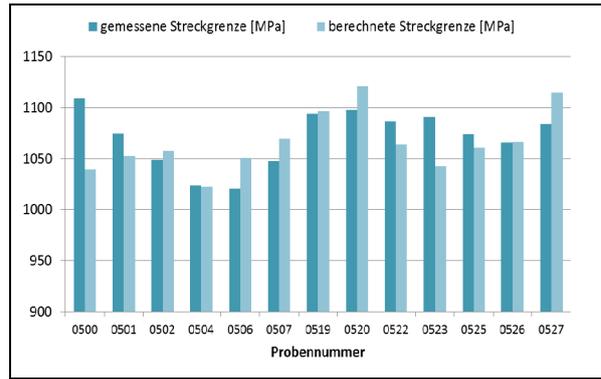


Fig. 3: Comparison of measured and calculated yield strength.



Impact and effects

The good agreement of calculated and measured yield strength values, and the possibility to explain the effect of micro alloying elements enable minimizing resources required.

The influences of other micro alloying elements can also be investigated in this way. The acquisition of the structure-properties-relationship and the influence of alloying elements should allow an active alloy development of ultra-high strength filler metals.

Contact und information

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