Alloy design of TRIP high-entropy alloys with precipitation strengthening

High-entropy alloys (HEAs) are a new, chemically complex and promising class of alloy. In contrast to conventional concepts, these alloys do not rely on principal element, but on four or more elements with atomic fractions between 5 and 35 %. When they were first synthesized, the formation of many intermetallic phases was expected, however, mostly alloys with simple crystal structures like fcc or bcc were obtained. This is a result of the high configurational entropy in multi-component alloys, which increases the stability of simple crystal structures. Due to the large degree of freedom in their composition, property combinations are possible which cannot be found in conventional alloys.

Based on this premise, a novel Fe_{50}Mn_{30}Co_{10}Ni_{10} HEA was developed, which is characterized by a good combination of strength and ductility. This is achieved by the additional activation of transformation-induced plasticity (TRIP), which can be controlled with the chemical composition. However, the mechanical properties of this alloy are still not as good as in conventional alloys. Therefore, vanadium carbide precipitates will be introduced into this alloy, which will increase their strength to compete with conventional alloys.

The aim of this work is to investigate the effects of vanadium carbides on the microstructural, mechanical and deformation properties of the TRIP-HEA. For this purpose, vanadium and carbon were alloyed to the base composition, which will be precipitated as carbides after heat treatment.

Tasks:

- Research on high-entropy alloys and strength increasing mechanisms.
- Development and implementation of heat treatments on cold rolled samples.
- Microstructure characterization using light and electron microscopy (SEM, EDS, EBSD).
- Mechanical and deformation property characterization using hardness and tensile testing.
- Interpretation of the results and preparation of the final thesis.

Experience:

- High interest in materials technology.
- High level of motivation and initiative.
- Interest in working with measurements and analysis technologies.

Start: Now

Group: Additive Manufacturing

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