Microstructure Modelling of Low Alloy Steels, Ti-Alloys and Superalloys

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ABSTRACT

Modelling additive manufacturing (AM) requires accounting for the microstructural changes in many cases. Plastic hardening of a material does change the structure of an alloy but microstructure does here denote phase changes typical for low alloy steels. The typical phases are then the body centred cubic lattice of ferrite and face centred cubic lattice of austenite but also formation of cementite. However, most microstructure models describe the micro-constituents where cementite is an ingredient. The described 'phase' change model [1] therefore accounts for formation of ferrite, austenite, pearlite, bainite and martensite fractions. The talk also describes a similar approach for Ti-6Al-4V [2]. Another described type of transformation is precipitate growth. This is illustrated for the case of Alloy 718 [3].

Enabling finite element simulation of AM of components requires that the microstructure modelling does not require that the mesh need not resolve the scale of the microstructure. Therefore, are these models are implemented as state variables. This means that each integration point in the mesh corresponds to a representative volume element that can have various fractions of the phases/constituents. Then each RVE does not interact with the other RVEs but they all extract their driving forces from a common thermal field.

The talk also introduces the coupling of this kind of models with constitutive models enabling the possibility to account for the corresponding changes in material properties.

REFERENCES

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