Grain Boundary Oxidation Processes and High Temperature Corrosion

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ABSTRACT

The formation of grain boundary and inner oxides at high temperatures has a significant impact on the mechanical properties of metallic substrates. Large amounts of oxides along the boundary layers often induce mechanical strain and affect the connectivity between the grains. As an ultimate result, some grains may fall off, which leads to roughening and the necessity of additional treatments to obtain the desired surface-finish.

The current research, which is a further development of the programme InCorr (GTT-Technologies and the University of Siegen, Germany), aims to give insight into the composition of oxidic phases in hot-rolled steel samples. Alloying elements like chromium, manganese, silicon and aluminium were considered due to their high importance in modern steel design.

Simulations were composed as a subsequent 2-step based algorithm, consisting of element migration and chemical reactions. Whilst the migration of the chemical species (i.e. iron, oxygen and the alloying elements) has been determined to be the rate limiting step, the chemical reactions were considered to be in local thermodynamic equilibrium under manufacturing conditions. Hence their amounts can be derived from the thermodynamic dataset from the FactSage programme.

The results can be summarised as a two dimensional map, indicating the amount and spatial distribution of each phase in a given sample microstructure. Additionally, these findings will be compared to experimental measurements and a short outlook of future plans will be presented.