Measurement and Simulation of Surface Tension of Liquid Steels

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ABSTRACT

In steelmaking, the knowledge of thermophysical properties like density, surface tension and viscosity in the liquid state plays an important role. For many steels, the ternary FeNiCr-system forms the basis. Therefore we selected this system as the starting point for the REXOS project with the goal to develop a database containing surface tensions of steels as functions of composition and temperature. Along carefully selected cuts in the ternary phase diagram, the surface tensions have been measured containerlessly by the oscillating drop method in combination with electromagnetic levitation. Simultaneously, the surface tensions will be calculated with a newly developed software, which is based on Butler's original concept of treating the surface as an additional thermodynamic phase, being in equilibrium with the bulk. The numerical implementation follows the concept of constrained Gibbs energy minimisation where the surface tension appears as a Lagrangian multiplier. This method can easily be implemented using GTT's own Programmer's Library ChemApp. As compared to the conventional Butler equation, this method is particularly effective for multicomponent systems. Using available data for the excess Gibbs free energies of the alloy, and values for the surface tensions and molar volumes of the pure components, the surface tension can be calculated as a function of temperature and composition and can be compared to the experimental results, allowing an optimisation of the database.