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Interfaces in liquid steel processing and related effects

ABSTRACT

Iron- and steelmaking processes are running in the temperature range between 1300°C and 1700°C. In all process steps the separation of liquid and solid phases plays a crucial role besides chemical reactions. The interfacial tension is a key property for phase separation which in turn is a result of running chemical reactions, local chemical and electrochemical potentials. In situ measurements and observations as well as in laboratory experiments and in the industrial processes will be presented.

The presentation will cover following topics:

-Effect of chemical reactions on interfacial tension between liquid steel and liquid slag

On both sides of the interface high concentration gradients of all elements exists in the range of approx. 150 nm in steel and 400 nm in slag. The molar mass flow rate of oxygen through the interface decreases the interfacial tension locally down to zero.

-Interfacial flow caused by local gradients of interfacial tension

The interfacial convection always occurs under industrial process conditions and increases the mass transport in the boundary layer. The maximum flow velocity in the boundary layer in liquid slag was estimated to 25^{-3} m/s.

-Non-metallic precipitations with different mineralogical composition – behaviour in liquid steel

The behaviour of different types of precipitations was examined in situ using confocal scanning laser microscope. Alumina particles attract strongly each other and agglomerate. Particles with other mineralogical composition do not attract and agglomerate.

-Effect of chemistry and external electrical potential on interfacial tension between liquid steel and liquid slag

Effect of slag and steel chemistry – basicity and O and S activities, respectively – on interfacial tension was experimentally investigated using the drop weight method. Additionally the effect of applied external electric potential was measured. O and S have a strong effect on interfacial tension and the zero charge potential is influenced by the slag chemistry.

Keywords: liquid steel, liquid slag, interfacial tension, precipitations, electric potential