

Neural Network Approach to Slag Viscosity / SlagVis

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Abstract

I have been investigating so far physico-chemical properties such as surface properties, viscosity etc. of metals, alloys, oxides and so on. The target of our investigation spreads in very wide range from nano scale materials to materials processing in the universe. For example, I have made binary alloy phase diagrams of nano particle on the basis of the evaluation of surface tension of solid & liquid alloys as well as normal phase diagrams by using thermodynamic databases in FactSage.

Recently, we have focused on the extraction of metals from lunar soil on the Moon. In the future, when we may live on the moon, we will need oxygen to survive. The lunar soil on the moon is generally composed of oxides. There is no air on the moon, but we could extract the oxygen from those soils, and simultaneously we could get metals from them. FactSage evaluation showed that iron oxide contained in the lunar soil can be easily reduced to metallic iron. In some experiments, we confirmed that small iron droplets were obtained in molten oxides when we melted the above soils. Here, in order to separate those small iron droplets from molten slag, we have to evaluate viscosity of molten slag. Various physical models have been reported to evaluate the viscosity of molten slag. In general, it is very difficult to evaluate the viscosity of molten silicate oxide in any kinds of multi-component systems because the viscosity changes widely with silicate concentration and temperature.

Then, we have tried a new approach, i.e. Neural Network Computation to evaluate the viscosity of molten slag. This technique has been already used in various fields on robotics, control engineering etc. When we have very complicated data which might have a certain correlation such as composition dependence of the viscosity of multi-component molten slag, it is very difficult to find a correlation among them. In such a case, the neural network computation can find a correlation of the viscosity of molten slag with concentration of several components and temperature. We have already applied this approach to evaluate the viscosity of molten flux for continuous casting technology in steelmaking process. We have also tried to evaluate the viscosity of molten slag composed of the lunar soils. RCCM(an agency in Tokyo) with GTT has developed a new software "SlagVis" on the basis of the above approach. I will explain our concept on the above study with some results in my presentation.