§8. To Develop a Method for Insitu Measurement of Thermal Balance under 30GHz Heating Making Iron

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Microwave technology is not only a promising alternative for conventional heating, but also it resides in the new domain of materials science, namely, microscopic and strong thermal non-equilibrium systems. The application of microwaves in the iron industry may be characterized by a high potential for an essential reduction of carbon dioxide emission. A series of experiments have been conduced to prove the effectiveness of rapid and high purity refinement under oxygen-containing environment by means of microwave application, and achieved highly positive results.

The making iron process became mainly deoxidization of iron oxide by carbon. Therefore, the boudouard reaction is used in blast furnace. The energy of carbon burning is used to provide the endothermic reaction, and CO gas became the reduction gas for deoxidization. The high temperature air is blown inside the conventional blast furnace for making iron. Then the atmosphere is mainly CO gas mixed CO2 gas in the blast furnace. On the oter hand, it is suggested that the solid-solid reaction on microwave making iron. The following paper discusses to develop a method for insitu measurements of thermal balance under 30GHz heating making iron.

For the mm-wave experiments, the applicator of a compact 30 GHz gyrotron system was used. The mm-wave power generated by a so called gyrotron oscillator can be controlled from 0 - 15 kW in cw operation. The heating process was controlled along a preset temperature-time program using the temperature signal of a thermocouple. There was the electrical balnce with microwave shield in the microwave applicator as showen in Figure 1.

The natural iron ores were used for microwave making iron at 30GHz. The sample is from KOBE STEEL LTD, mainly Fe3O4 and impurity was 88.5 %. The natural iron ores were mixed with ratio that the gas of CO2 to CO were one to zero, one to one, and one to two like pure magnetite

Figure 2 shows the changed weight of thermal insulation (per unit) without sample respect with temperature under 30 GHz heating. The calculated function was obtained with thermal balance. Figure 3 shows the changed weight of sample respect with temperature under 30 GHz heating. The sample weight predominantly changed in the temperature range from 900 °C to 1200 °C.

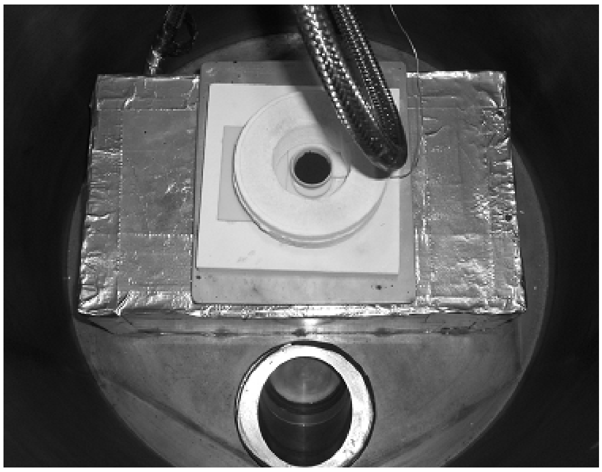

Figure 1: The picture of thermal balance in microwave applicator

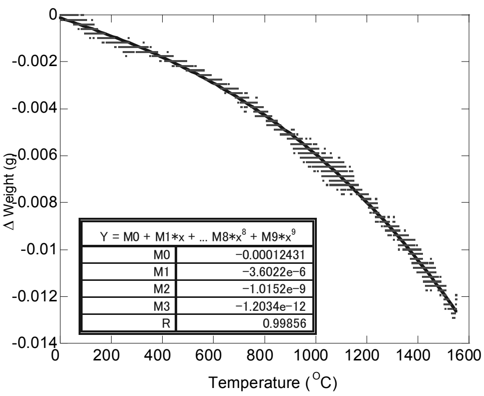

Figure 2: The changed weight of thermal insulation (per unit) without sample respect with temperature under 30 GHz heating.

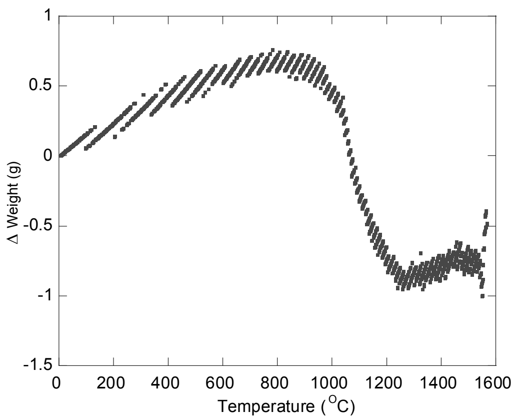

Figure 3: The changed weight of sample respect with temperature under 30 GHz heating.