Direct Observation of Reduction of Iron Ores and Melting Processes - Experiments in a Scanning Microscope with possibility of High Temperature and Gas-Treatment [+1]

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In this paper investigations concerning the reduction behaviour of iron oxides in the microscopic scale are presented. These examinations were intended to clarify the physical changes of iron oxides resulting from the reduction process. It is important to know these factors, as the morphology of reduced products influences the reduction and melting behaviour in the blast furnace.
The investigations were carried out based on a newly developed attachment unit to the Scanning Electron Microscope (SEM) [1,2,3] which enables investigations under simultaneous gas and heat treatment to be conducted. In this way it is possible to observe continously reduction and even melting processes.
The attachment unit to the SEM is characterized by: direct heating of the specimen, high heating rates, use of a powerful turbo-molecular vacuum pump, protection of the detector unit against incoming light and thermal electrons, preheating of the gas stream.
When both micro- and macrostructure of a specimen (crack forming, change in volume) are to be observed [4] a periodic mode of procedure is applied in addition to the continuous mode. Reduction tests under systematically variying reduction conditions with CO/CO_2 and H_2 reduction gases were carried out. The main topics were: pore and crack formation, change in volume during reduction, sintering of reduced layers, non-isothermal reduction and growth of fibrous iron. By means of direct observation it was clearly shown, that needles-haped iron grows from the bottom, as shown in figure 1. Resulting from these observations a model for the growth mechanism is presented.
The results obtained are discussed in relation to their relevance to blast furnace behaviour in conjunction with data obtained from Japanese investigations on quenched blast furnaces.

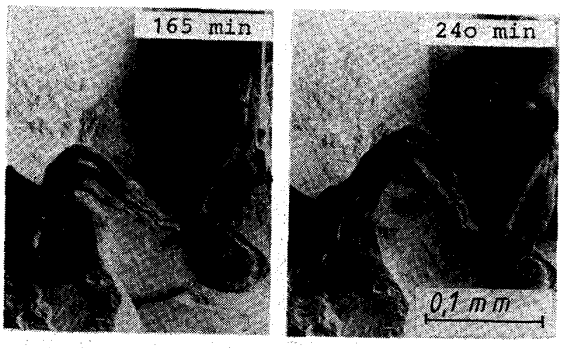

Figure 1: Growth of iron needles, reduction with CO, T = 1000 °C

In further investigations it could be shown that even the field of melting zones can be investigated in the SEM. Figure 2 shows for example a specimen, consisting of sponge iron, reduced in the attachment unit, the specimen being heated up to melting temperature for short times. During the high temperature treatment a covering molten layer is formed, in which a coagulated slag phase has seperated out dendritically.
Furthermore it has been revealed, that the combination of reduction under non-isothermal conditions in the SEM with x-ray constration mapping and with the observation of the melting processes of one and the same spot on the specimen gives significant results.

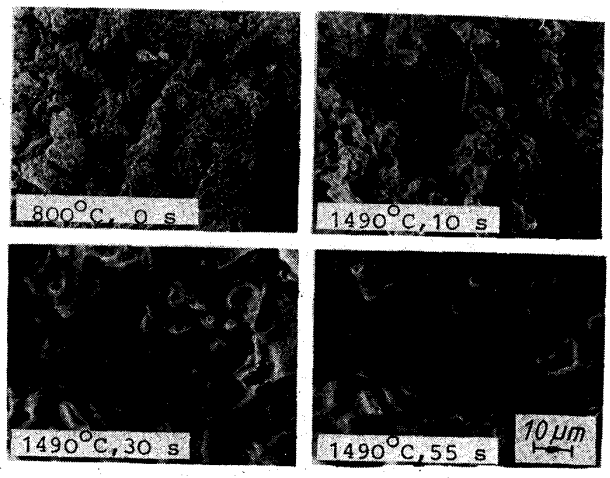

Figure 2: High-Temperature-Melt down of Sishen Ore, after prereduction in the attachment unit

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