論文 / 著書情報
Article / Book Information

題目(和文)	高被還元性焼結鉱の鉱物相、形態及び成分に基づいた設計指針
Title(English)	Designing of Iron Ore Sinters with High Reducibility from the Perspective of Mineral Phases, Morphologies and Chemical Compositions
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出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第10946号, 授与年月日:2018年9月20日, 学位の種別:課程博士, 審査員:林 幸,須佐 匡裕,史 蹟,木村 好里,上田 光敏
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第10946号, Conferred date:2018/9/20, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	要約
Type(English)	Outline

Designing of iron ore sinters with high reducibility from the perspective of mineral phases, morphologies and chemical compositions
(高被還元性焼結鉱の鉱物相、形態及び成分に基づいた設計指針)

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Dissertation outline:

In low carbon reduction steelmaking, iron ore sinters with high reducibility are needed to improve the permeability of the blast furnace. However, because of the complex microstructures and chemical compositions of iron ore sinters and that the temperature as well as gas components change depending on the position of the furnace, there are few reports focusing on the factors dominating the reducibility of iron ore sinters from a comprehensive perspective including mineral phases, morphologies and chemical compositions. Thus, in the present work, the factors dominating the reducibility of iron ore sinters have been examined by comparing the reducibility of iron ore sinter samples, hematite ore sample and synthesized samples with homogeneous microstructures using high temperature X-ray diffraction (XRD) analysis and electron probe microanalysis (EMPA). High temperature XRD analysis was applied to the samples heated in a condition simulating a blast furnace. Finally, the guidelines for the designing of iron ore sinters with high reducibility were proposed from the perspectives of mineral phases, morphologies and chemical compositions.

The content of each chapter is introduced as follows briefly:

Chapter 1 "Introduction": This chapter introduces the significance of this study and states the objectives of this doctoral thesis.

Chapter 2 "Investigation of the reducibility of iron ore sinters": Reducibility of five kinds of iron ore sinters: Sinter-A, Sinter-B, Sinter-C, Sinter-D and Sinter-E have been evaluated using high temperature X-ray diffraction (XRD) analysis in an atmosphere simulating a blast furnace. Electron probe microanalysis (EPMA) has been used to observe microstructures of these samples, and the compositions of each mineral phase have been quantitatively analyzed by point analysis at room temperature, the effects of mineral phases and gangue mineral concentrations on the reducibility of iron ore sinters have been examined.

Chapter 3 "Reducibility of wüstite and calcio-wüstite in terms of high temperature X-ray diffraction analysis": The difference between the reducibility of different mineral phases: FeO reduced form Fe_2O_3 and CW reduced from SFCA has been evaluated using high temperature X-ray diffraction (XRD) analysis. The XRD profiles have been regressed to the Pseudo-Voigt function to calculate peak area and peak diffraction angle of main mineral phases to obtain the information about the reducibility of FeO and CW during reduction process.

Chapter 4 "Comparison between reducibilities of columnar silico-ferrite of calcium and aluminum (SFCA) covered with slag and acicular SFCA with fine pores": The difference between two types of SFCA, *i.e.*, columnar SFCA covered with slag and acicular SFCA with fine pores has been examined from the perspective of morphology and chemical composition. The samples have been synthesized using chemical reagents and iron ore powders. XRD analysis has been applied to the samples heated in an atmosphere simulating a blast furnace. Electron probe microanalysis (EPMA) has been applied to observe the microstructures of the samples before and after heating and to quantitatively investigate the concentration changes with time of CaO, SiO_2 and Al_2O_3 in CW. The effects of morphology and gangue mineral concentration on the reducibility of columnar CW reduced from columnar SFCA covered with slag and acicular CW reduced from SFCA with fine pores have been compared.

Chapter 5 "Effect of MgO concentration on reducibility of magnecio-ferrite and magnecio-wüstite": The effect of solid solution amount of MgO on the reducibility of magnetite and wüstite has been evaluated. MgO-Fe_3O_4 samples with different solid solution amount of MgO have been synthesized using MgO and Fe_3O_4 chemical reagents. XRD analysis has been applied to the samples heated in an atmosphere simulating a blast furnace. Electron probe microanalysis (EPMA) has been applied to observe the microstructures of the samples after heating and to quantitatively investigate the concentration changes with time of MgO in MgO-FeO.

Chapter 6 "Guidelines for designing iron ore sinters with high reducibility": Conclusions about factors dominating the reducibility of iron ore sinters in chapter 3 ~ 5 have been reviewed, results about factors influencing the reducibility of practical iron ore sinters in chapter 2 have been explained and guidelines for designing iron ore sinters with high reducibility have been proposed.

Chapter 7 "Conclusions": Conclusions of the whole thesis have been given.