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高铁三水铝石型铝土矿烧结过程中氧化铝反应热力学

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摘要: 研究了高铁三水铝石型铝土矿烧结过程中 Al_2O_3 与 CaCO_3 、 CaO 、 SiO_2 及 FeO 反应的热力学规律。结果表明: 在1 473-1 673 K温度下, Al_2O_3 比 Fe_2O_3 更易与 CaCO_3 反应; Al_2O_3 与铁酸钙($2\text{CaO}\cdot\text{Fe}_2\text{O}_3$ 和 $\text{CaO}\cdot\text{Fe}_2\text{O}_3$)反应不能生成 $3\text{CaO}\cdot\text{Al}_2\text{O}_3$, 当烧结温度大于1 000 K时, 可以与 $2\text{CaO}\cdot\text{Fe}_2\text{O}_3$ 反应生成 $12\text{CaO}\cdot 7\text{Al}_2\text{O}_3$; SiO_2 比 Al_2O_3 更易与 CaO 结合, Al_2O_3 与 SiO_2 直接反应生成硅酸铝的可能性较小; 当烧结温度为1 473-1 673 K时, 除 $\text{CaO}\cdot 2\text{Al}_2\text{O}_3$ 和 $\text{CaO}\cdot\text{Al}_2\text{O}_3$ 不能向 $3\text{CaO}\cdot\text{SiO}_2$ 转变外, 其余铝酸钙均可在 SiO_2 的作用下向硅酸钙转变; $2\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{SiO}_2$ 是 CaO 、 Al_2O_3 和 SiO_2 三者直接反应的产物, 不能由硅酸钙和铝酸钙相互反应生成; CaO 、 Fe_2O_3 、 Al_2O_3 和 SiO_2 四元矿物存在时, 烧结过程优先生成 $2\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{SiO}_2$ 和 $4\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{Fe}_2\text{O}_3$, 这与烧结实验结果相符。

关键字: 三水铝石; 铝土矿; 铁矿石; 烧结; 氧化铝

Thermodynamics of reaction of alumina during sintering process of high-iron gibbsite-type bauxite

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Abstract: The thermodynamics of the reactions of alumina(Al_2O_3) with CaCO_3 , CaO , SiO_2 and FeO in the sintering process of high-iron gibbsite-type bauxite was investigated. The results show that alumina reacts with calcium carbonate much easier than ferri oxide(Fe_2O_3) at the industrial sintering temperature of 1 473-1 673 K. Alumina can not react with calcium ferrites($2\text{CaO}\cdot\text{Fe}_2\text{O}_3$ and $\text{CaO}\cdot\text{Fe}_2\text{O}_3$) to form $3\text{CaO}\cdot\text{Al}_2\text{O}_3$, but when temperature is over 1 000 K alumina reacts with $2\text{CaO}\cdot\text{Fe}_2\text{O}_3$ to form $12\text{CaO}\cdot 7\text{Al}_2\text{O}_3$. SiO_2 reacts with CaO much easier than Al_2O_3 . The possibility of alumina silicate from direct reaction of Al_2O_3 with SiO_2 is little. Except for $\text{CaO}\cdot 2\text{Al}_2\text{O}_3$ and $\text{CaO}\cdot\text{Al}_2\text{O}_3$, the other calcium aluminates can transform into calcium silicate by reacting with SiO_2 . Gehlenite($2\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{SiO}_2$) can not be formed from the reaction of

calcium silicate($\text{CaO}\cdot\text{SiO}_2$) with calcium aluminate($\text{CaO}\cdot\text{Al}_2\text{O}_3$), but it can be directly formed from the reaction of CaO , Al_2O_3 and SiO_2 . When CaO , Fe_2O_3 , Al_2O_3 and SiO_2 coexist in the sintering process, they are more likely to form ternary compound $2\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{SiO}_2$ and $4\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{Fe}_2\text{O}_3$, which is consistent with the sintering results in laboratory.

Key words: gibbsite; bauxite; iron ore; sintering; alumina

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