Supplementary material

Microwave Roasting of Blast Furnace Slag for Carbon Dioxide Mineralization and Energy Analysis

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Formula S1. Calculation of CO_2 capture potential

The capture potential of carbon dioxide is closely related to the content of calcium and magnesium in raw materials. The capture potential of a certain raw material can be calculated by the following reaction formula:

$M^{2+} + 2OH^- + CO_2 \rightarrow MCO_3 + H_2O$ (M=Ca or Mg)

Amount of M in one ton Ti-bearing blast furnace slag:

Ca: 1000kg × 18.24% ×1/40.08 = 4.551kmol

Mg: 1000kg × 4.07% ×1/24.30 = 1.675kmol

The capture potential of carbon dioxide:

(1.67 kmol+ 4.55 kmol)×44.01= 274.0kg

Reaction	Conversion rate
$MO + (NH_4)_2SO_4 = MSO_4 + 2NH_3 + H_2O \quad (M = Ca, Mg, ...)$ $M_2O_3 + 3(NH_4)_2SO_4 = M_2(SO_4)_3 + 6NH_3 + 3H_2O \quad (M = Al, Fe, ...)$ $MO_2 + (NH_4)_2SO_4 = MOSO_4 + 2NH_3 + H_2O \quad (M = Ti, ...)$ $(NH_4)_2SO_4 = NH_4HSO_4 + NH_3$	93.3% (Sulfation ratios of Ca)
$2NH_3 + CO_2 + H_2O = (NH_4)_2CO_3$	100%
$TiOSO_4 + H_2O = TiO_2 \downarrow + H_2SO_4$	95.7%
$Al_2(SO_4)_3 + 6NH_3 \cdot H_2O = Al(OH)_3 + 3(NH_4)_2SO_4$	99.7%
$MgSO_4 + 2(NH_4)_2CO_3 + 4H_2O = (NH_4)_2Mg(CO_3)_2 \cdot 4H_2O \downarrow + (NH_4)_2SO_4$	91%
$CaSO_4 + (NH_4)_2CO_3 = CaCO_3 \downarrow + (NH_4)_2SO_4$	100%
$CaSO_4 + (NH_4)_2CO_3 = CaCO_3 \downarrow + (NH_4)_2SO_4$	99.7%
$(NH_4)_2Mg(CO_3)_2 \cdot 4H_2O = MgCO_3 + NH_3 + CO_2 + 4H_2O$	100%

Table S1. Conversion rate of main reactions in material balance

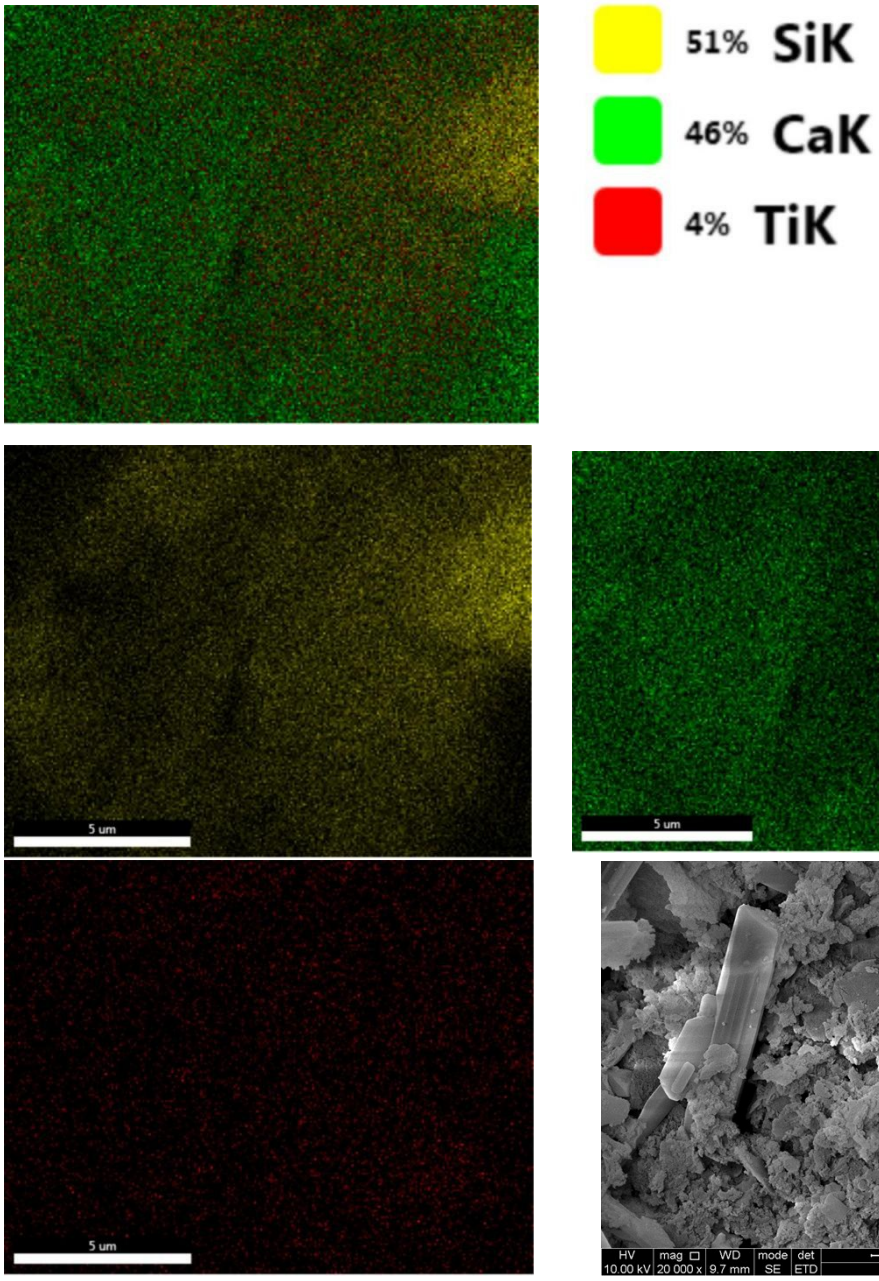

Figure S1. EDS analysis results of leaching residue

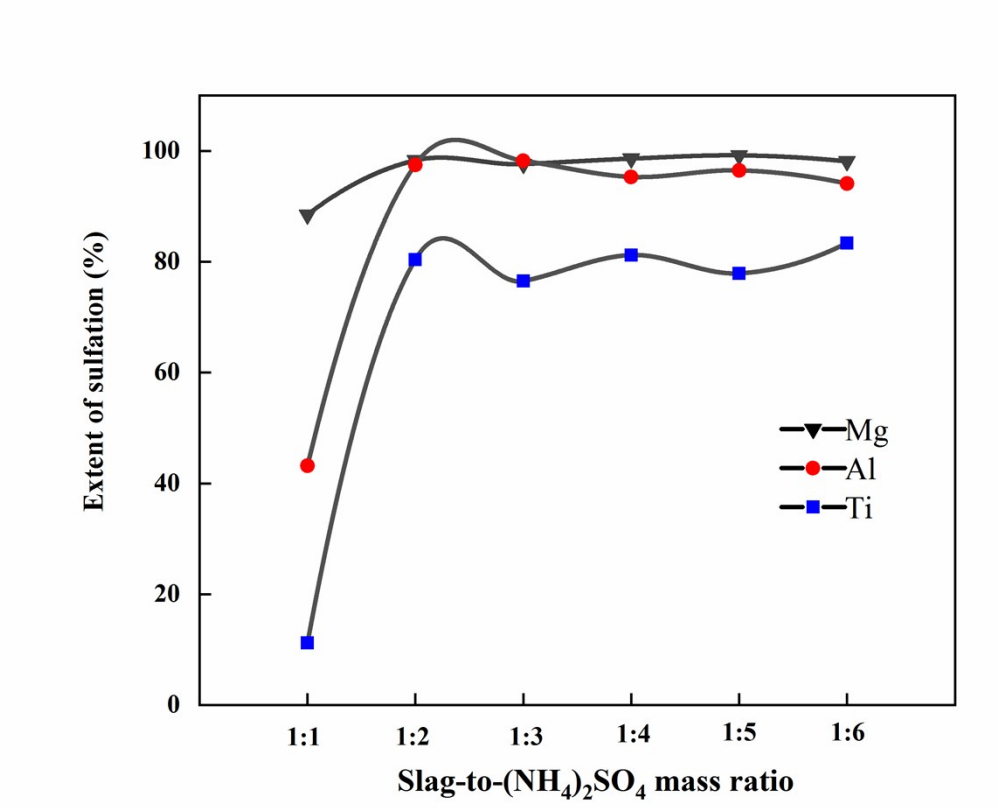

Figure S2. The effect of slag-to-$(NH_4)_2SO_4$ mass ratio on the sulfation of Mg, Al and Ti

0min

2min-(1)

4min（TiO_2 generated）

10min（TiO_2 generated）

2min-(2)

Figure S3. Photos of products at different holding times