

Supporting Information

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RESEARCH ARTICLE

Reaction kinetics of CaC_2 formation from powder and compressed feeds

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Abstract The production of CaC_2 from coke/lime powders and compressed powder pellets are low cost and fast processes. A number of studies have reported the reaction kinetics of these reactions but they are still not well understood and the proposed kinetic models are not comparable due to differences in the reaction conditions. Therefore the reaction behavior of CaO/C powders (0.074 mm) and cubes ($5 \times 5 \times 4.6\text{--}5.1$ mm) compressed from a mixture of powders have been studied using thermal gravimetric analysis (TGA) at 1700–1850 °C. Kinetic models were obtained from the TGA data using isoconversional and model-fitting methods. The reaction rates for the compressed feeds were lower than those for the powder feeds. This is due to the reduced surface area of the compressed samples which inhibits heat transfer from the surrounding environment (or the heating source) to the sample. The compression pressure had little influence on the reaction rate. The reaction kinetics of both the powder and the compressed feeds can be described by the contracting volume model $f(\alpha) = 3(1 - \alpha)^{2/3}$, where α is the conversion rate of reactant. The apparent activation energy and pre-exponential factor of the powder feed were estimated to 346–354 $\text{kJ}\cdot\text{mol}^{-1}$ and $5.9 \times 10^7 \text{ min}^{-1}$ respectively whereas those of the compressed feed were 305–327 $\text{kJ}\cdot\text{mol}^{-1}$ and $3.6 \times 10^6 \text{ min}^{-1}$, respectively.

Keywords calcium carbide, kinetic model, activation energy, pre-exponential factor

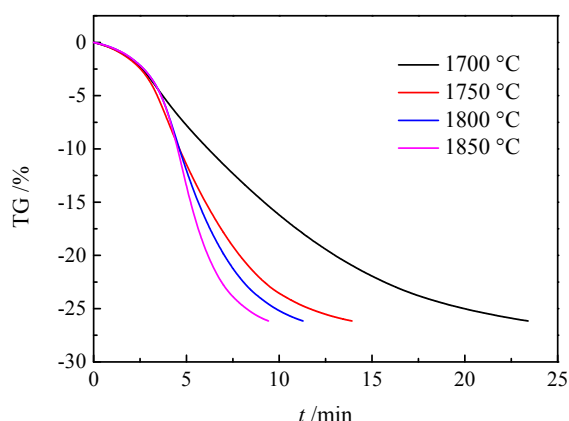


Fig. S1 Corrected TG curve during reaction of the powder feed at various temperatures

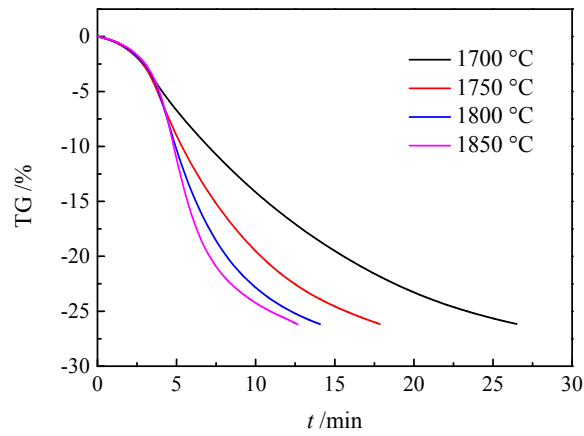


Fig. S2 Corrected TG curve during reaction of the compressed feed Cube-148 at various temperatures

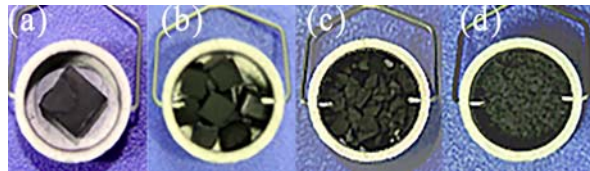


Fig. S3 Pictures of the compressed feeds with different sizes. (a) $5 \times 5 \times 5$ mm, (b) $2.5 \times 2.5 \times 2.5$ mm, (c) 1.0 mm, and (d) 0.4 mm. All feeds are derived from sample Cube-69 ($5 \times 5 \times 5$ mm) by cutting or grinding

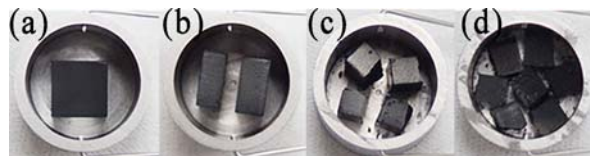


Fig. S4 Pictures of the compressed feeds with different sizes by cutting sample Cube-69 of $5 \times 5 \times 5$ mm into various sizes. (a) $5 \times 5 \times 5$ mm, (b) $2.5 \times 5 \times 5$ mm, (c) $2.5 \times 2.5 \times 5$ mm, and (d) $2.5 \times 2.5 \times 2.5$ mm