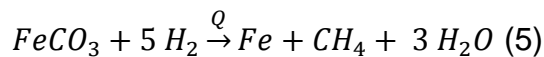
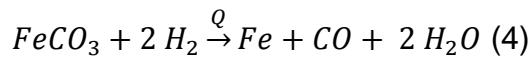
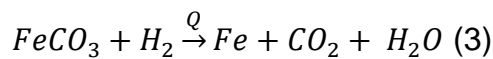
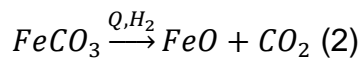
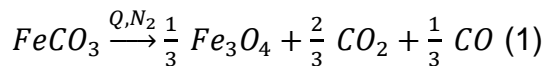


CO₂ hydrogenation during FeCO₃ (Siderite) reduction

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The catalytic hydrogenation of carbon dioxide, makes use of CO₂ as a huge carbon resource for chemical hydrogen storage. Iron is frequently used as a catalyst. The hydrogenation of CO₂ has been greatly investigated with synthetically produced iron catalysts.

In our project, we focused on the hydrogenation of CO₂ combined with the reduction of siderite. FeCO₃ (Siderite) is a major raw material in the iron production. The metallurgical state-of-the-art processing of siderite consists of calcining of FeCO₃ in a sinter plant to hematite (Fe₂O₃), which then reacts with CO to form a pig iron smelter in the blast furnace. H₂ reduces iron carbonate directly to elemental iron or iron oxide (Wustite), and CO₂ is partially hydrogenated to methane and carbon monoxide. The experiments were conducted in a tubular reactor on bench scale. The temperature range was 350°C to 500°C, the pressure range was from ambient pressure to 1.5 MPa. Through variation of the reaction parameters (temperature, pressure, hydrogen atmosphere) the effect of operation conditions on the product yield was investigated. While reduction of iron carbonate in nitrogen produces magnetite (Fe₃O₄), CO₂ and CO according to (Eq. 1), H₂ atmosphere enables formation of wustite (FeO) (Eq. 2), elemental iron (Eq. 3), as well as CO₂ (Eq. 3), CO (Eq. 4) and CH₄ (Eq. 5).



High pressures and low temperatures facilitate methane formation, while at elevated temperature and low pressure CO plus CO₂ formation is preferred.

The direct reduction of iron carbonate with H₂ to elemental iron consumes less reducing agent and emits less CO₂ compared with the state-of-the-art technology of calcining in the sinter plant and reduction of hematite/magnetite in the blast furnace.