

**Solid State Ionics**  
Volume 177, Issues 1-2, 16 January 2006, Pages 45-51

doi:10.1016/j.ssi.2005.10.005

## Kinetic and thermodynamic considerations for oxygen absorption/desorption using cobalt oxide

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Received 3 June 2004; revised 5 August 2005; Accepted 3 October 2005. Available online 28 November 2005.

### Abstract

Cobalt oxide absorbs oxygen as the high-temperature rock-salt CoO structure is transformed into the lower-temperature cubic Co<sub>3</sub>O<sub>4</sub> spinel. The absorption and desorption processes are reversible, which makes the material a potential candidate for use in temperature and/or pressure swing absorption modes for the production of oxygen. TGA/DTA experiments were conducted to quantify the kinetics and thermodynamics of the reaction. Over the temperature range investigated, both absorption and desorption were highly dependent on the thermodynamic driving force with faster kinetics occurring as  $\Delta G$  became more negative. The reaction kinetics were primarily controlled by heat transfer and the thermodynamic driving force. Kinetic data suggest that cobalt oxide of 1–5  $\mu\text{m}$  particle size can be oxidized or reduced at temperatures 40° above or below 890 °C in air, in less than 10 min at a bed thickness of 10 mm. A large change in enthalpy ( $\Delta H \approx 195 \text{ kJ/mol}$ ) as Co<sub>3</sub>O<sub>4</sub> is converted to CoO affects heat transfer and the economy of producing oxygen by this method.

**Keywords:** Oxygen transport; Reaction kinetics; Thermodynamic driving force; Cobalt oxide

### Article Outline

1. [Introduction](#)
2. [Experimental](#)
3. [Results](#)
4. [Discussion](#)
5. [Conclusions](#)

[Acknowledgement](#)

[References](#)