Moisture-triggered carbonation of metal oxides under elevated CO$_2$-partial pressures

Carbonates could be a suitable class of materials for thermochemical energy storage, especially when higher partial pressures of CO$_2$ are applied. A selection of metal oxides, which according to thermodynamic data should readily undergo carbonation, were investigated in the herein reported study.

Carbonation of the oxides was investigated at temperatures below 100 °C and CO$_2$ pressures of 1-55 bar (25 °C) and 110 bar (60 °C) by *in-situ* powder X-ray diffraction, as well as using experiments in a pressure reactor. Moisture was confirmed to be a crucial requirement for any successful carbonation, as under dry conditions always the initial metal oxides were recovered.

For the experiments in the presence of moisture (partial) carbonation of CaO, MnO, ZnO, CoO and PbO was achieved. To characterize the energy storage potential of these materials experiments using a high-pressure thermogravimetry and differential scanning calorimetry were performed.

**Fig. 1a** Carbonation of CaO under 3 bar of wet CO$_2$

**Fig. 1b** Carbonation of CaO under 8 bar of wet CO$_2$

**Fig. 1c** Carbonation of CaO under 55 bar of wet CO$_2$