Oral presentation

Tracking the formation of $MgCO_3$ in a $NaNO_3$-promoted MgO-based CO_2-sorbents by synchrotron diffraction studies

Paula Abdala; Christoph Müller; Margarita Rekhtina

bdalap@ethz.ch

MgO, promoted with $NaNO_3$, is a class of CO_2 sorbents that shows great promise for industrial applications in pre- and post-combustion CO_2 capture processes. These sorbents offer a high theoretical gravimetric CO_2 capacity of 1.09 g CO_2 per g viz. MgO, $MgO+CO_2 \rightarrow MgCO_3$ $\Delta H^{300K} = -106.05$ kJ mol^{-1}, are naturally abundant, and environmentally friendly. However, MgO has slow carbonation kinetics, and therefore, requires promoters, which are typically alkali molten metal nitrates. There is active research to advance these materials by improving their CO_2 uptake rates and cyclic stability whereby our research aims to understand the underlying structure-performance relationships [1-4]. In this presentation, we will present a series of studies that employ in situ synchrotron X-ray diffraction in combination with laboratory-based methods to shed light on the mechanisms that occur at the atomic level during CO_2 capture on MgO-based CO_2-sorbents. We uncover the growth mechanism of $MgCO_3$ under practically relevant conditions using a MgO(100) single crystal coated with $NaNO_3$ as a model system. [1-2]. Furthermore, we use in situ time-resolved X-ray powder diffraction to monitor the structural changes in nanocrystalline MgO promoted with $NaNO_3$. [4]. Our findings allowed us to correlate the kinetics of $MgCO_3$ formation with the structural changes that occur in the sorbent during cyclic operation. Overall, these insights provide useful design guidelines to improve the CO_2 uptake performance of MgO-based CO_2 sorbents.

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