## **Supporting Information**

## CO<sub>2</sub> absorption and desorption characteristics of MgO-based absorbent promoted by triple eutectic alkali carbonate

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Fig. S1 Time-dependent CO<sub>2</sub> absorption data of 60-TEC/MgO absorbent at various temperatures.



**Fig. S2** Time-dependent CO<sub>2</sub> absorption data of x-TEC/MgO absorbents (x = 20, 40, 60, 80 and 100) in the conventional unit of % weight gain, redrawn from **Fig. 1**.



Fig. S3 Time-dependent CO<sub>2</sub> absorption data of dummy 60-TEC/Y<sub>2</sub>O<sub>3</sub> absorbent.



Fig. S4 Time-dependent TGA data of pure TEC at 370 °C under 100% CO<sub>2</sub>.



Fig. S5 *In-situ* XRD data of x-TEC/MgO absorbents before and after pre-treatment. (a) x = 20, (b) 60, and (c) 100.



Fig. S6  $N_2$  adsorption and desorption, pore size distributions of MgO (reference), 20- and 100-TEC/MgO absorbents



Fig. S7 Comparison of XRD pattern of phase 1 with other known related phases in the literature.



**Fig. S8** Peak indexation results of **phase 1** formed in 60-TEC/MgO absorbent after 180 min of CO<sub>2</sub> absorption.



Fig. S9 (Upper panels) Variations of *ex-situ* XRD peak intensities of **phase 1** and MgCO<sub>3</sub> in (a) 60and (b) 100-TEC/MgO absorbents as a function of time spent at 360 °C under 100% CO<sub>2</sub>. The intensity data are normalized values against the intensities of respective phases at 180 min. The intensity data were obtained by integrating a representative peak in each phase as marked in the figure. (Lower panels) Time-dependent CO<sub>2</sub> absorption data of respective absorbents taken from Fig. 1 for comparison.

Table S1. Lattice parameters of MgO phases in pure MgO and x-TEC/MgO absorbents after pre-

treatment of heating at 400 °C under 100%  $N_2$ .

	Lattice parameter (Å) <sup>a</sup>
MgO	4.218(2)
20-TEC/MgO	4.204(2)
60-TEC/MgO	4.204(2)
100-TEC/MgO	4.205(2)

<sup>a</sup>Calculated by the least-squares method of the peak positions of MgO in the diffraction patterns in Fig. S5.