

## Electronic Supplementary Information

### **Unravelling the Role of Alkaline Earth Metal Carbonate in Intermediate Temperature CO<sub>2</sub> Capture by Alkali Metal Salt-Promoted MgO-Based Sorbents**

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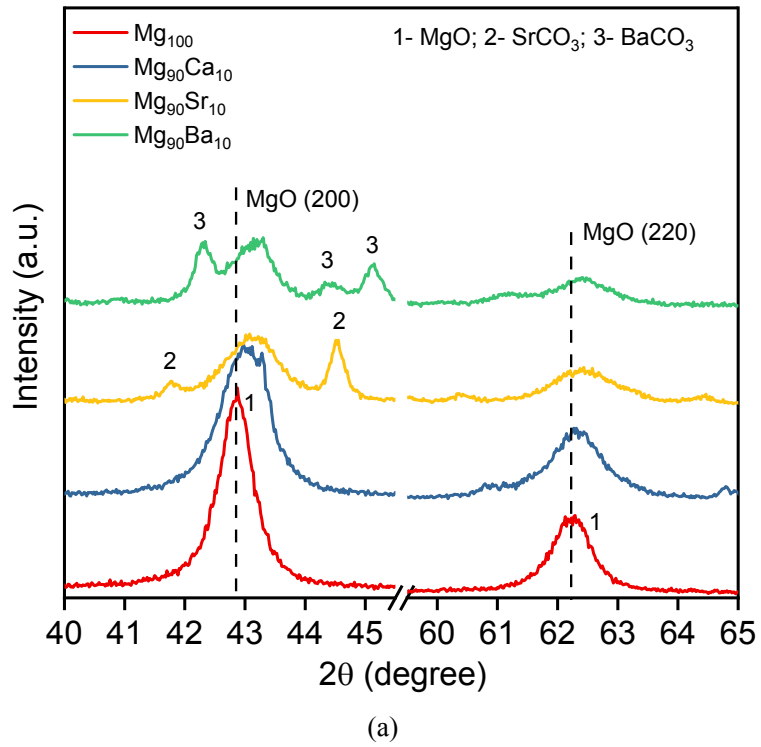
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**Table S1** Estimated kinetic parameters for the AMS-promoted  $\text{AeCO}_3$ -doped MgO-based sorbents

Sorbents	$T$ [°C]	$k_1$ [ $\text{min}^{-1}$ ]	$k_2$ [ $\text{min}^{-1}$ ]	$R^2$
AMS-Mg <sub>100</sub>	260	0.148	0.017	0.990
	280	0.221	0.023	0.973
	300	0.305	0.039	0.985
	320	0.380	0.073	0.980
AMS-Mg <sub>90</sub> Ca <sub>10</sub>	260	0.216	0.013	0.972
	280	0.317	0.022	0.984
	300	0.377	0.036	0.985
	320	0.465	0.057	0.971
AMS-Mg <sub>90</sub> Sr <sub>10</sub>	260	0.153	0.010	0.986
	280	0.259	0.019	0.967
	300	0.312	0.027	0.987
	320	0.394	0.052	0.997
AMS-Mg <sub>90</sub> Ba <sub>10</sub>	260	0.193	0.010	0.961
	280	0.291	0.014	0.984
	300	0.348	0.027	0.998
	320	0.442	0.049	0.980



Samples	Lattice parameter
	[nm]
Mg <sub>100</sub>	0.4224
Mg <sub>90</sub> Ca <sub>10</sub>	0.4218
Mg <sub>90</sub> Sr <sub>10</sub>	0.4214
Mg <sub>90</sub> Ba <sub>10</sub>	0.4213

(b)

**Fig. S1** (a) XRD patterns and (b) lattice parameters of AeCO<sub>3</sub>-doped MgO.

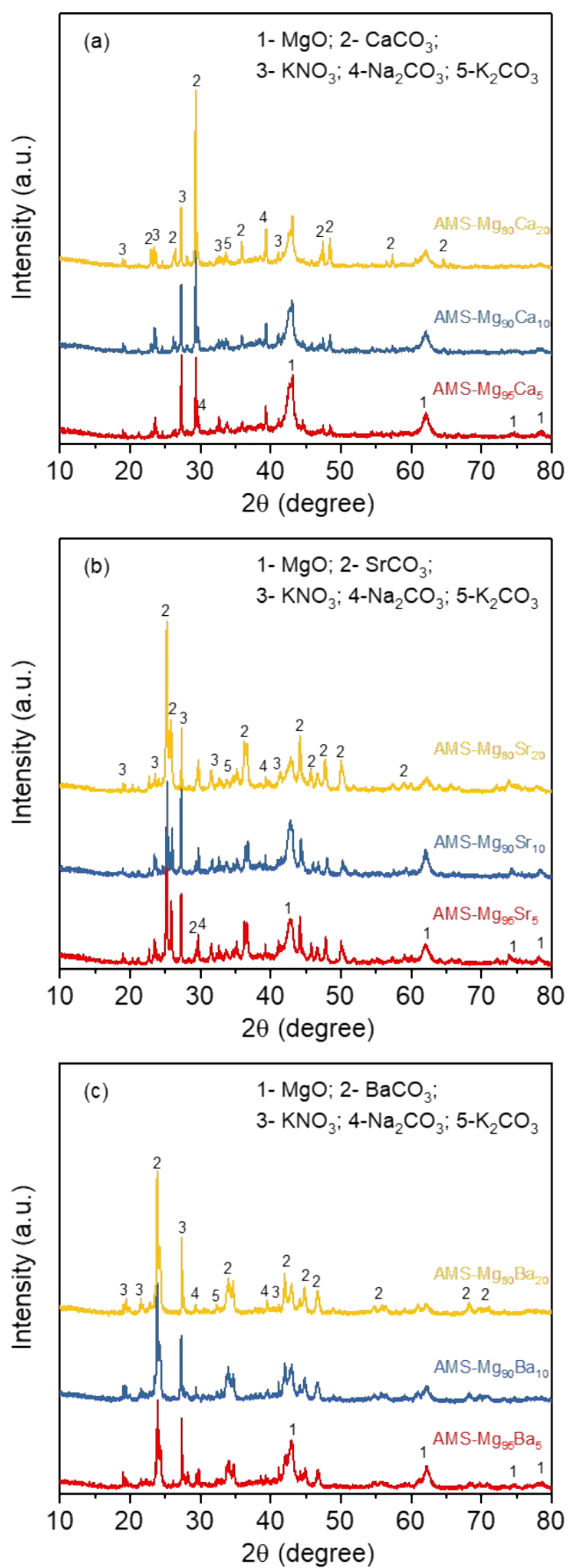
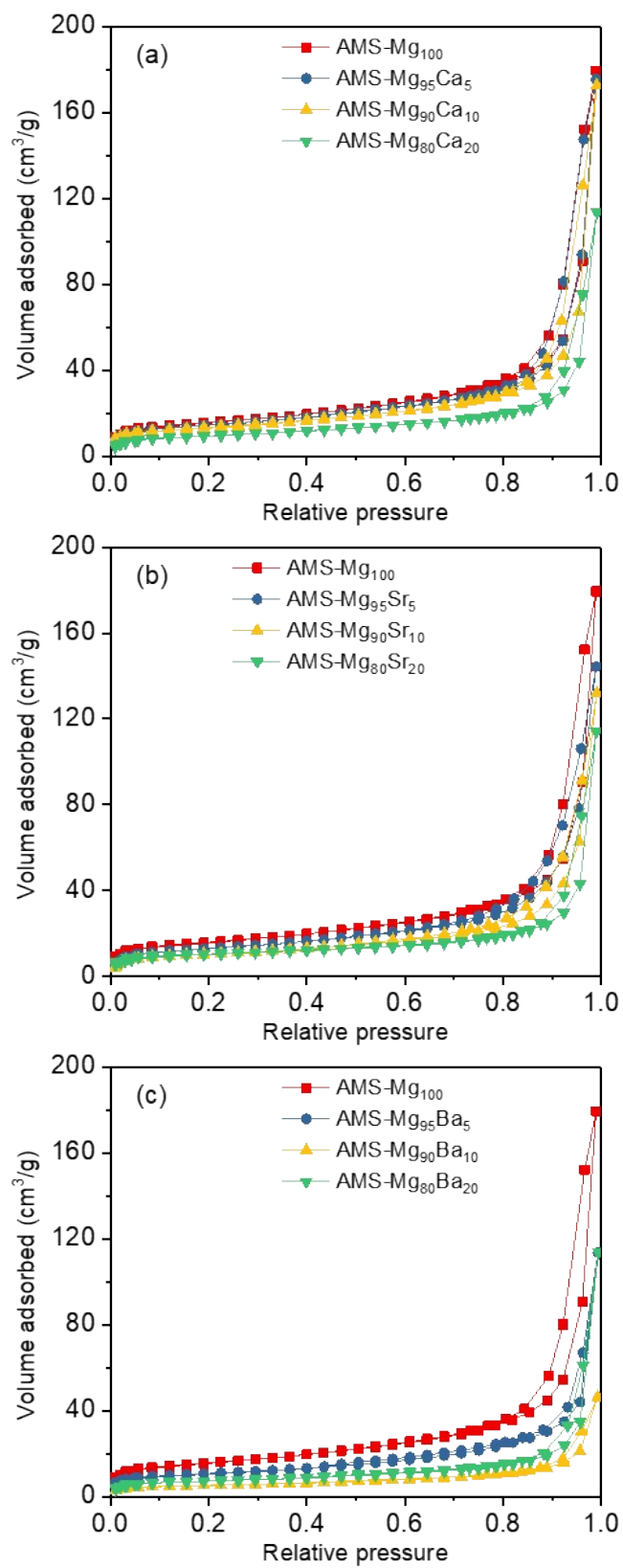
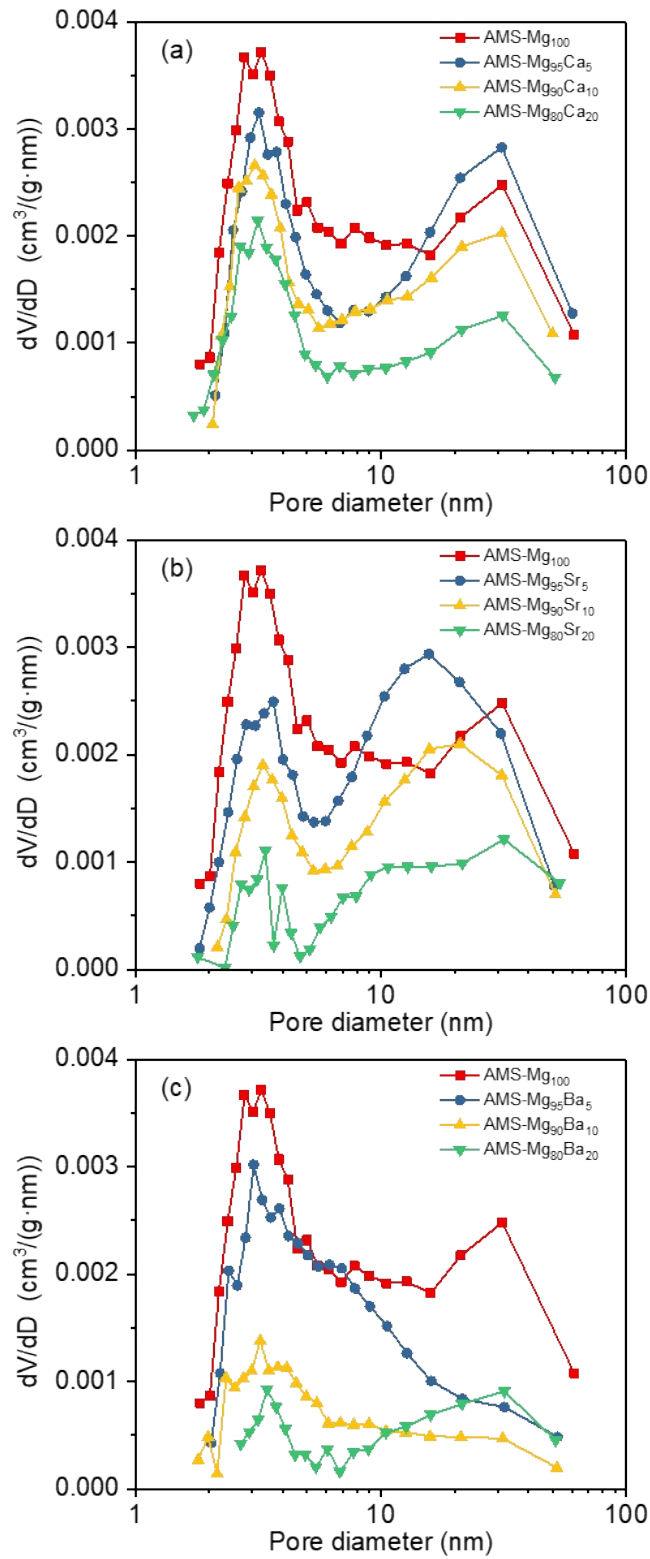


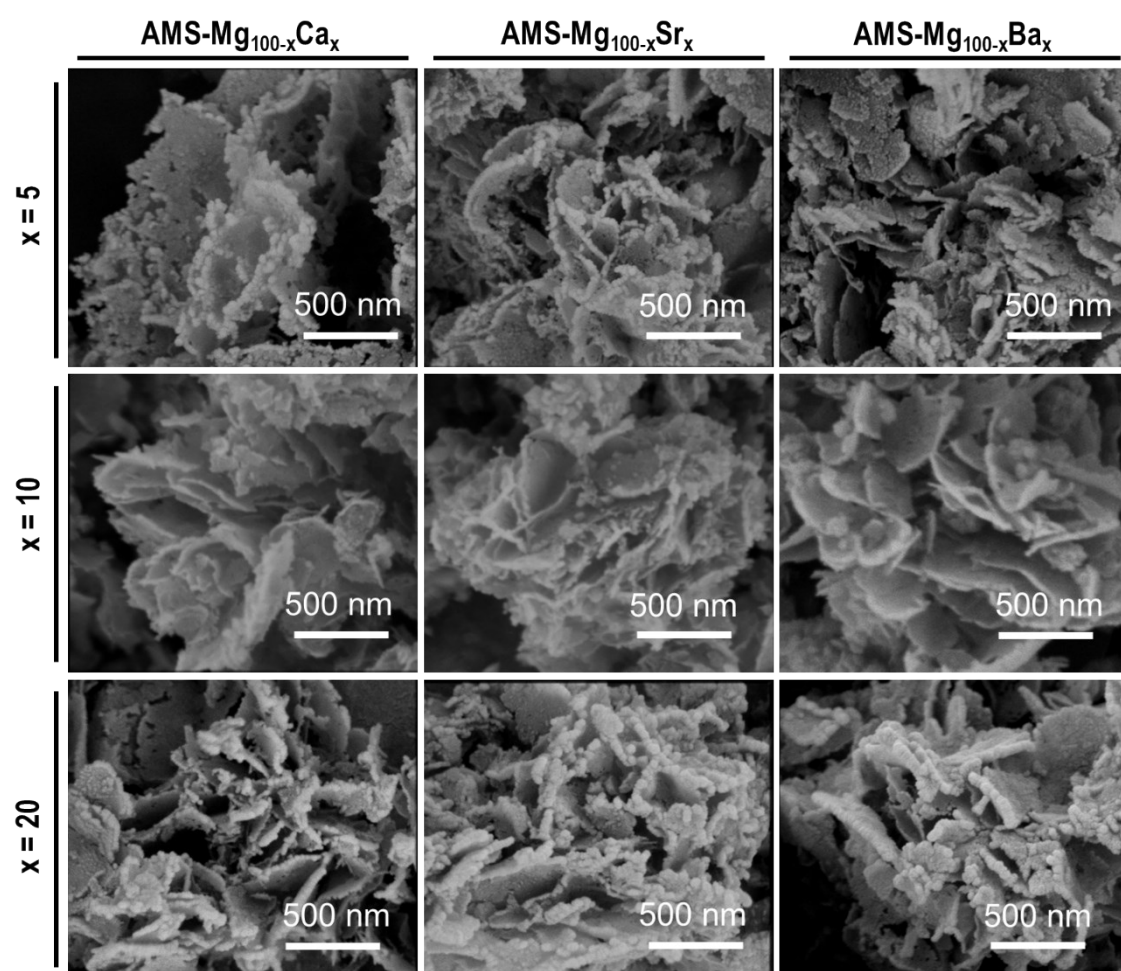
Fig. S2 XRD patterns of AMS-promoted MgO doped with (a) CaCO<sub>3</sub>, (b) SrCO<sub>3</sub> and (c) BaCO<sub>3</sub>.



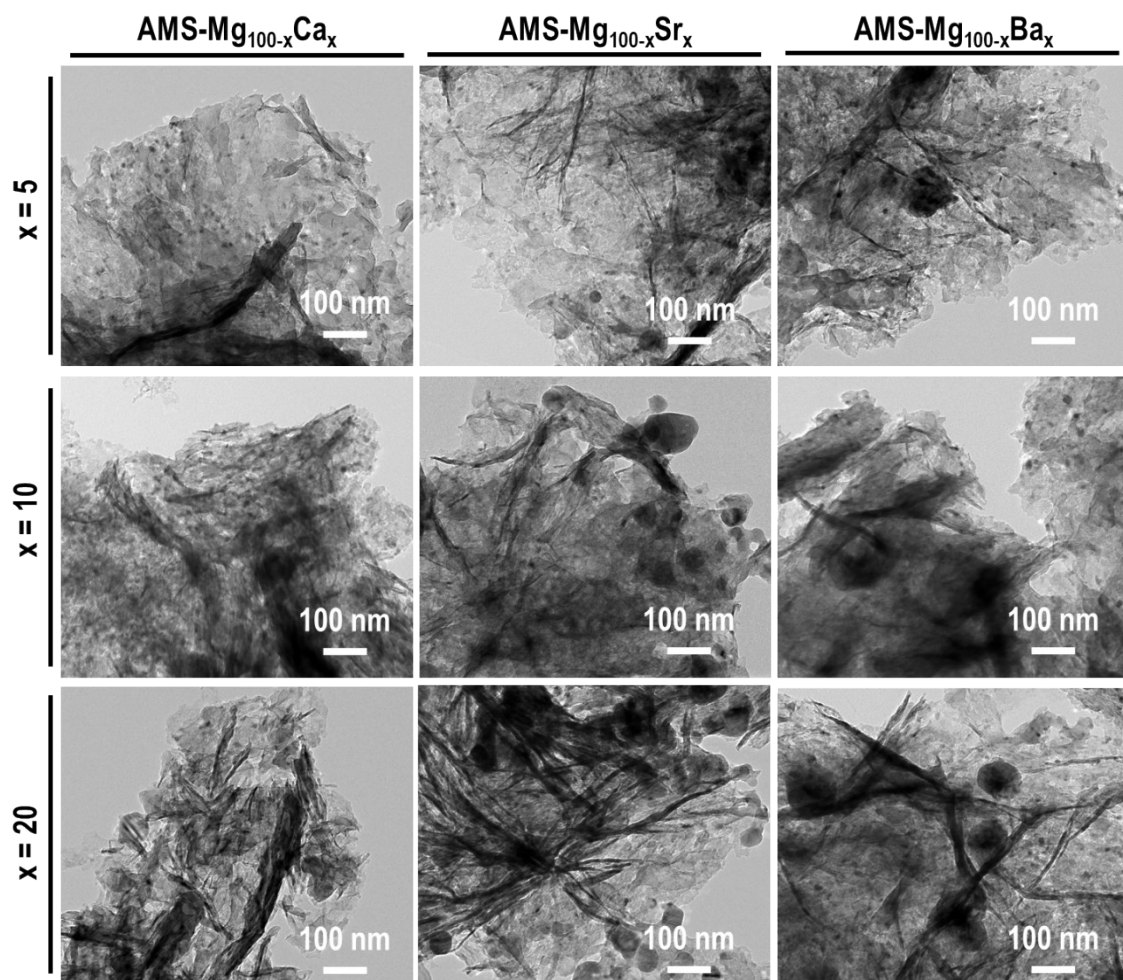
**Fig. S3** N<sub>2</sub> physisorption isotherms of AMS-promoted MgO doped with (a) CaCO<sub>3</sub>, (b) SrCO<sub>3</sub> and (c) BaCO<sub>3</sub>.



**Fig. S4** Pore size distribution curves of AMS-promoted MgO doped with (a)  $\text{CaCO}_3$ , (b)  $\text{SrCO}_3$  and (c)  $\text{BaCO}_3$ .

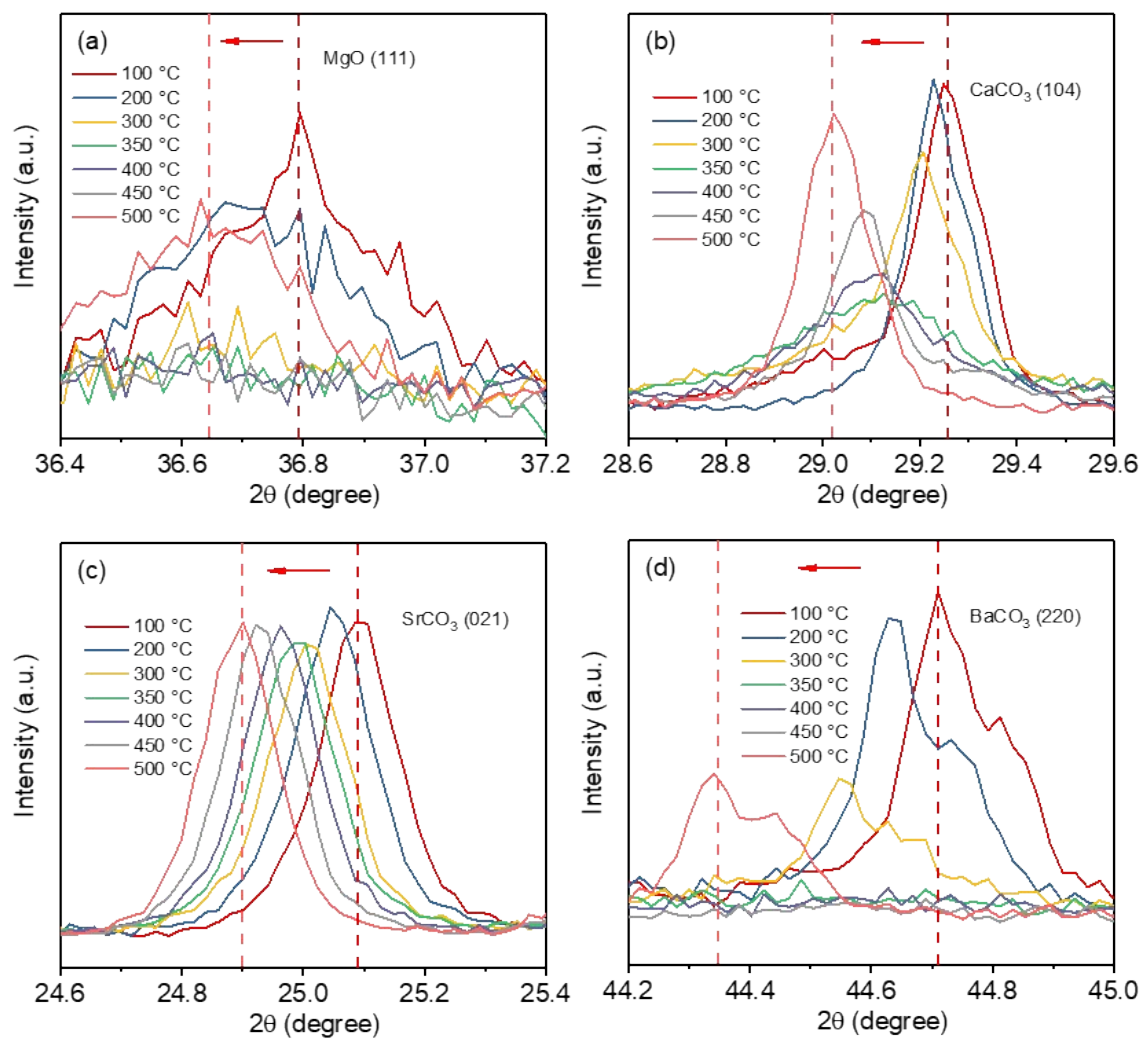


**Fig. S5** FESEM images of fresh AMS-promoted  $\text{AcCO}_3$ -doped MgO sorbents.

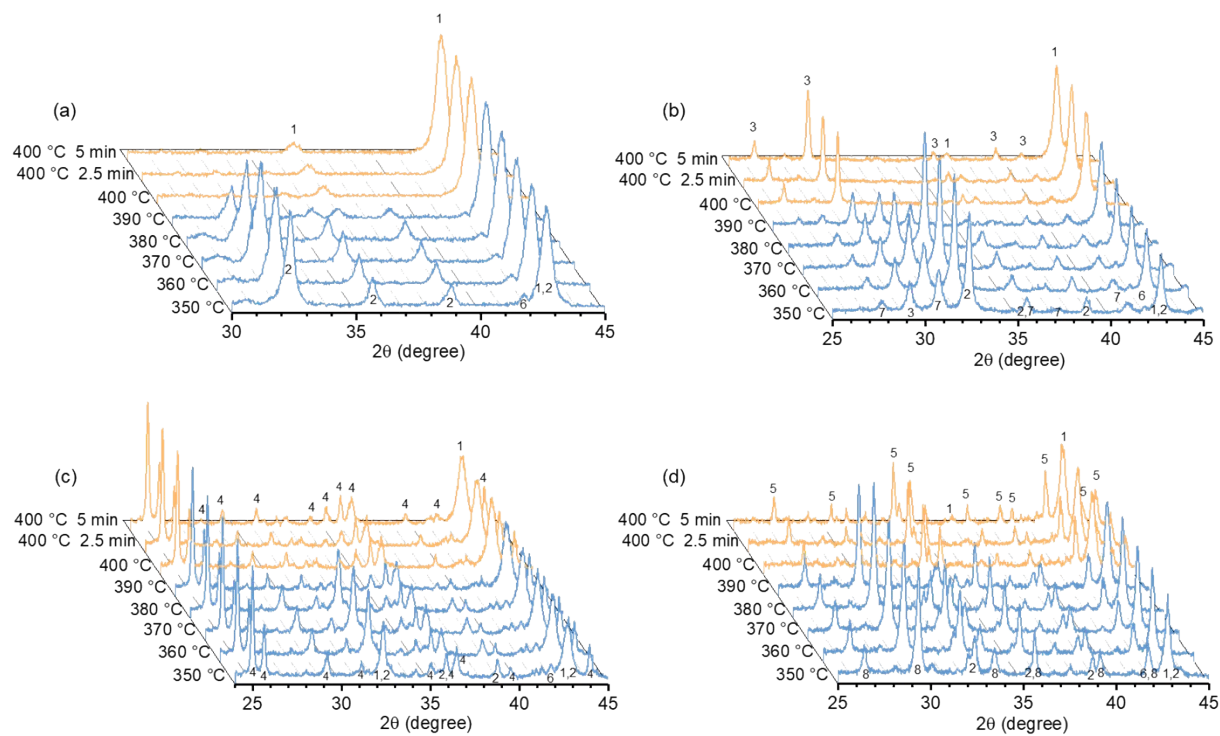


**Fig. S6** HRTEM images of fresh AMS-promoted  $\text{AcCO}_3$ -doped MgO sorbents.

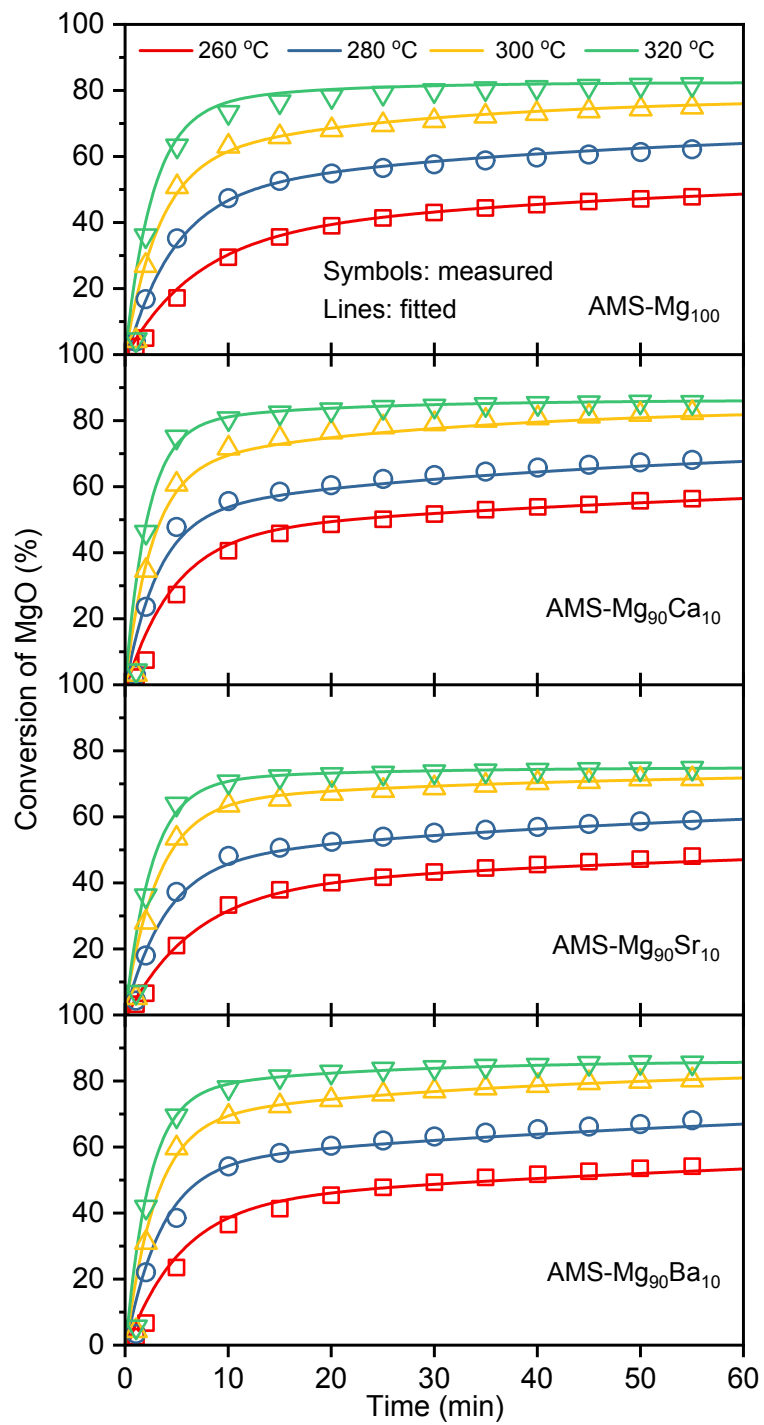




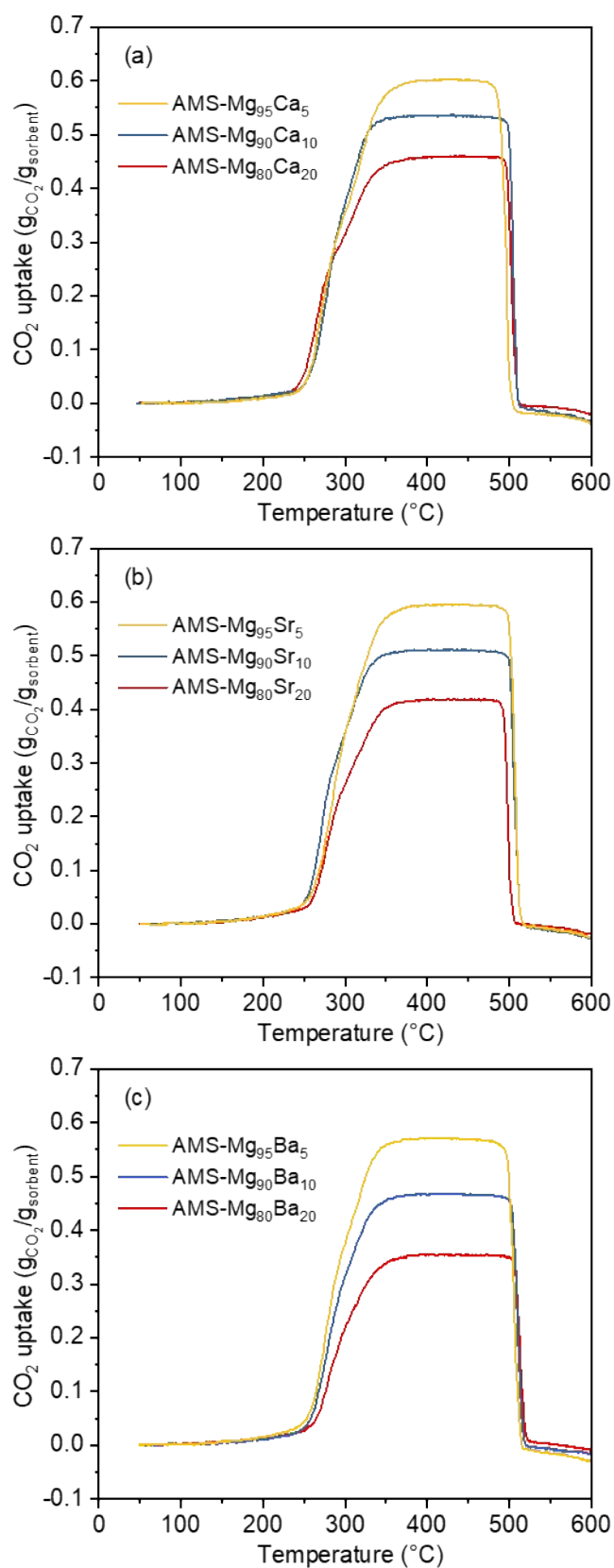
**Fig. S7** Diffractograms recorded by in-situ XRD analysis of (a) AMS-Mg<sub>100</sub>, (b) AMS-Mg<sub>90</sub>Ca<sub>10</sub>, (c) AMS-Mg<sub>90</sub>Sr<sub>10</sub> and (d) AMS-Mg<sub>90</sub>Ba<sub>10</sub> when heating from 100 to 500 °C in CO<sub>2</sub>.



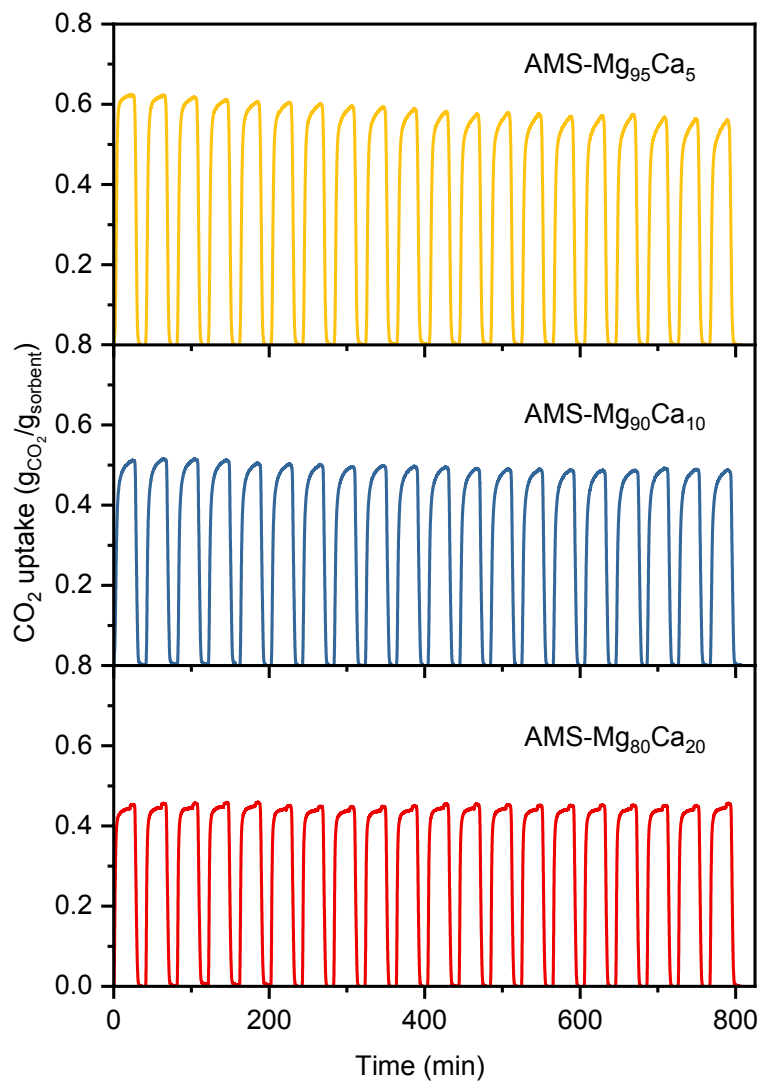
**Fig. S8** Diffractograms recorded by in-situ XRD analysis during regeneration of (a) AMS-Mg<sub>100</sub>, (b) AMS-Mg<sub>90</sub>Ca<sub>10</sub>, (c) AMS-Mg<sub>90</sub>Sr<sub>10</sub> and (d) AMS-Mg<sub>90</sub>Ba<sub>10</sub> from 350 to 400 °C in N<sub>2</sub>. (1-MgO; 2-MgCO<sub>3</sub>; 3-CaCO<sub>3</sub>; 4-SrCO<sub>3</sub>; 5-BaCO<sub>3</sub>; 6-K<sub>2</sub>Mg(CO<sub>3</sub>)<sub>2</sub>; 7-CaMg(CO<sub>3</sub>)<sub>2</sub>; 8-BaMg(CO<sub>3</sub>)<sub>2</sub>).



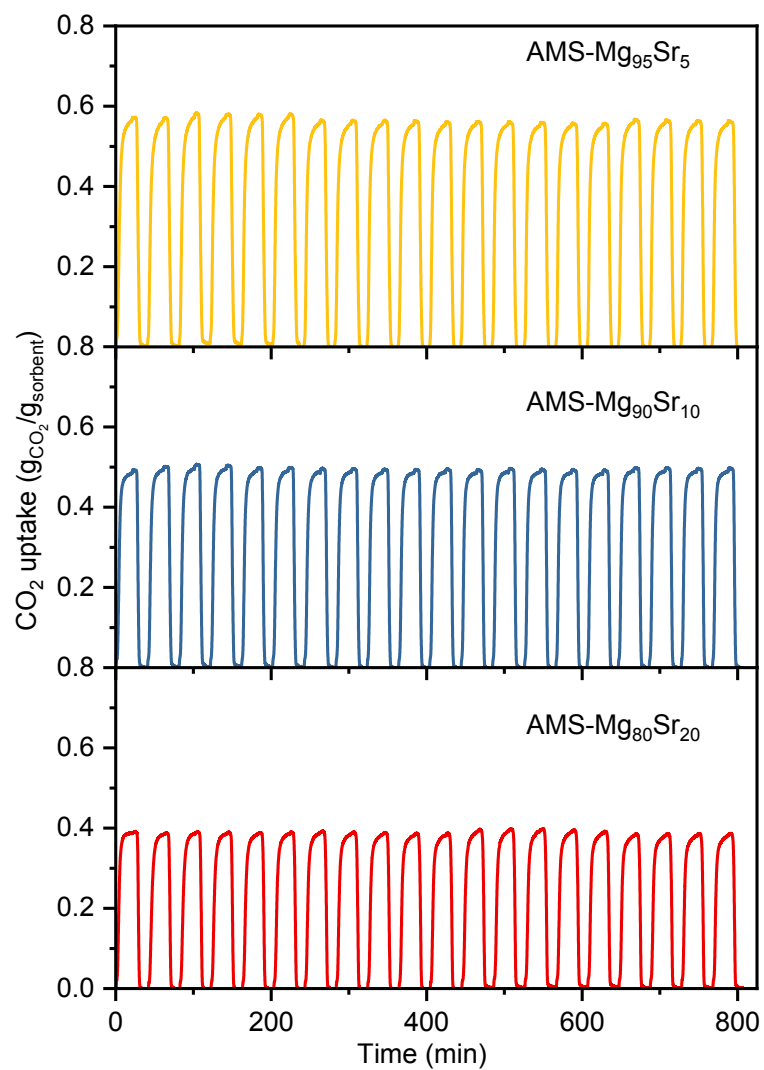
**Fig. S9** Measured and fitted CO<sub>2</sub> uptake of AMS-promoted AeCO<sub>3</sub>-doped MgO sorbents in CO<sub>2</sub>.



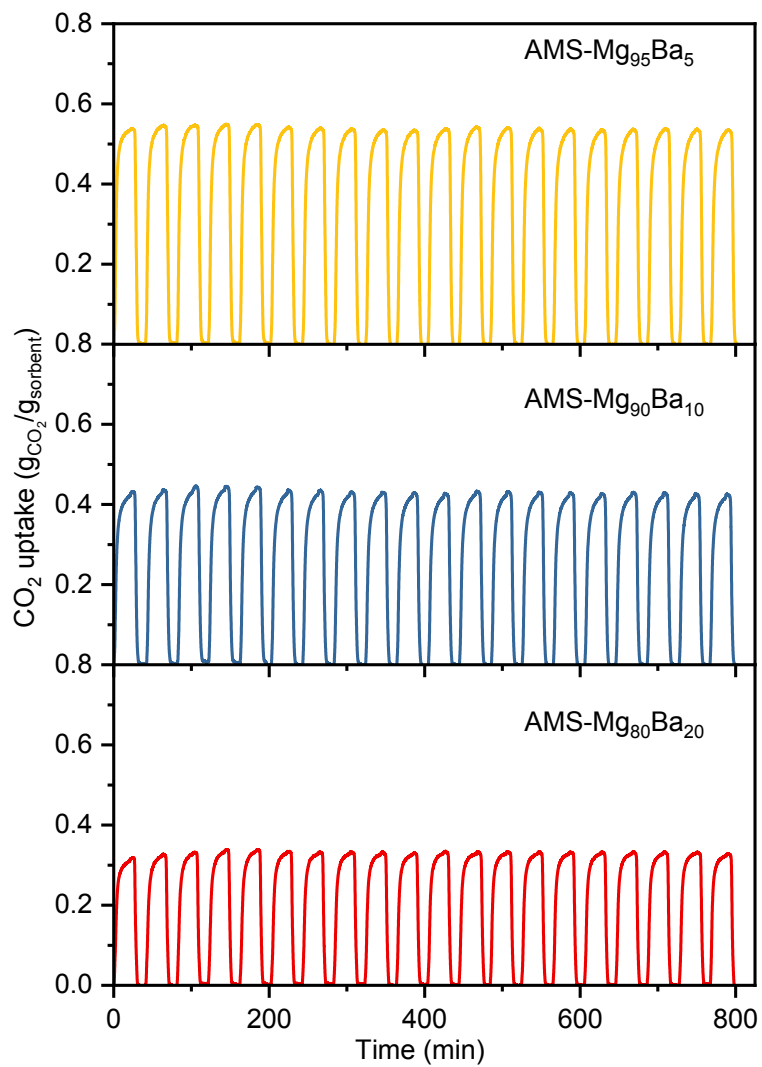
**Fig. S10** Dynamic thermograms of AMS-promoted MgO doped with (a) CaCO<sub>3</sub>, (b) SrCO<sub>3</sub> and (c) BaCO<sub>3</sub> (10 °C/min, in CO<sub>2</sub>)



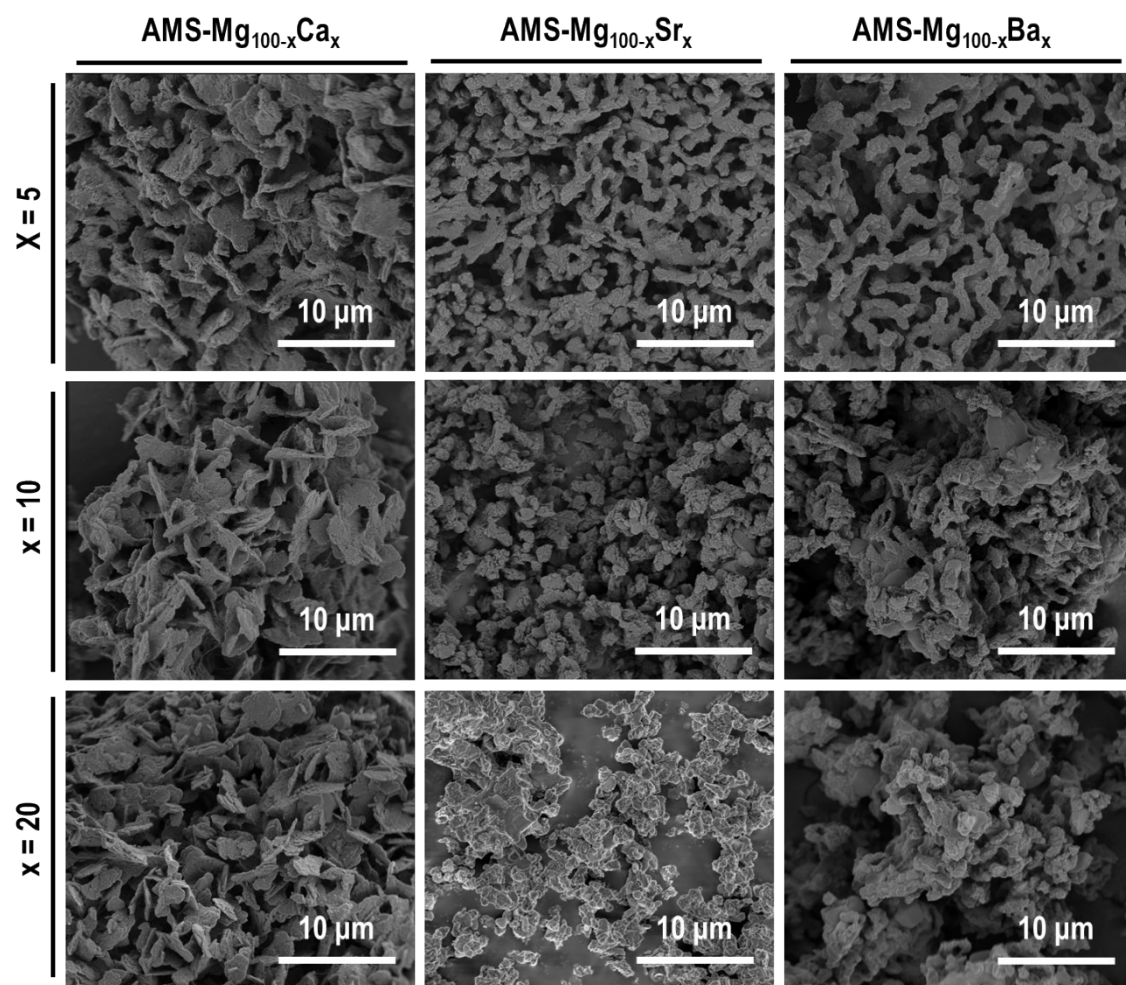
**Fig. S11** CO<sub>2</sub> uptake profiles of AMS-promoted CaCO<sub>3</sub>-doped MgO sorbents in 20 cycles (sorption: 350 °C for 20 min in CO<sub>2</sub>; regeneration: 400 °C for 10 min in N<sub>2</sub>; heating/cooling rate: 10 °C/min).



**Fig. S12** CO<sub>2</sub> uptake profiles of AMS-promoted SrCO<sub>3</sub>-doped MgO sorbents in 20 cycles (sorption: 350 °C for 20 min in CO<sub>2</sub>; regeneration: 400 °C for 10 min in N<sub>2</sub>; heating/cooling rate: 10 °C/min).

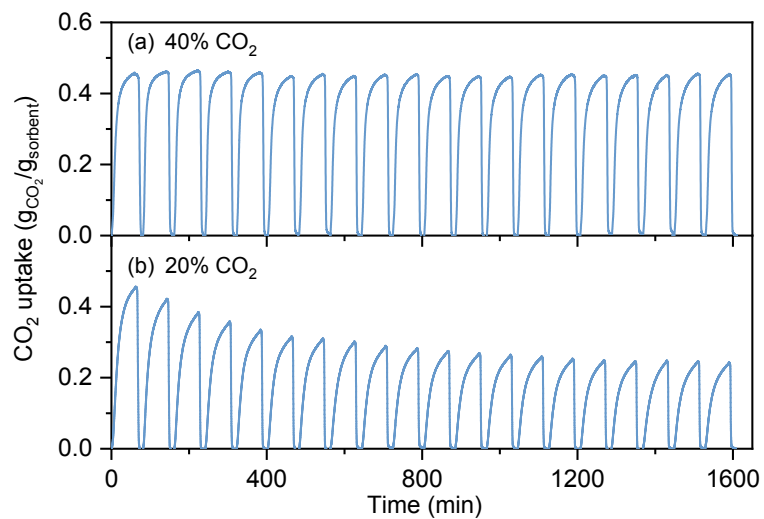


**Fig. S13** CO<sub>2</sub> uptake profiles of AMS-promoted BaCO<sub>3</sub>-doped MgO sorbents in 20 cycles (sorption: 350 °C for 20 min in CO<sub>2</sub>; regeneration: 400 °C for 10 min in N<sub>2</sub>; heating/cooling rate: 10 °C/min).



**Fig. S14** FESEM images of 20 cycle-used AMS-promoted  $\text{AcCO}_3$ -doped MgO sorbents.





**Fig. S15** CO<sub>2</sub> uptake profiles of AMS-Mg<sub>90</sub>Ca<sub>10</sub> in 20 cycles (sorption: 300 °C for 60 min in (a) 20% CO<sub>2</sub> or (b) 40% CO<sub>2</sub>; regeneration: 400 °C for 10 min in N<sub>2</sub>; heating/cooling rate: 20 °C/min).