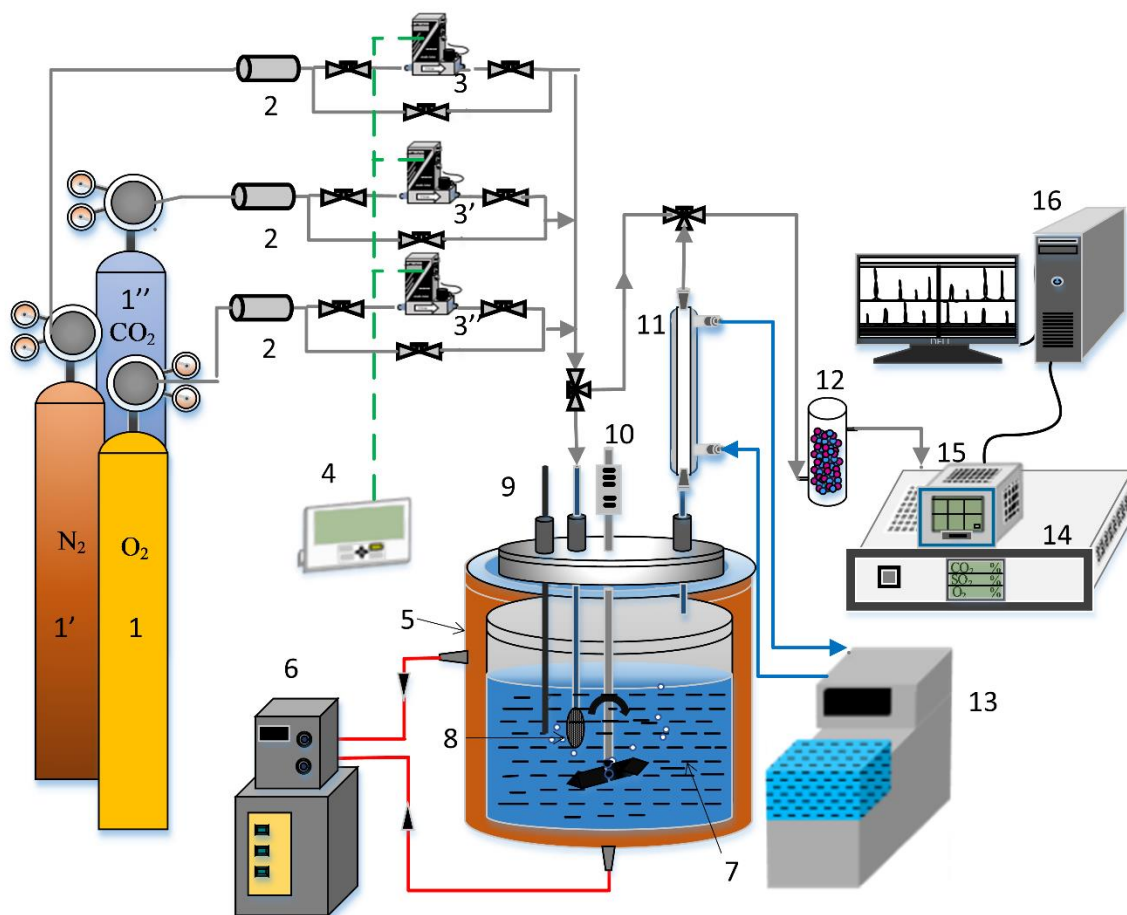


Supplementary Information for

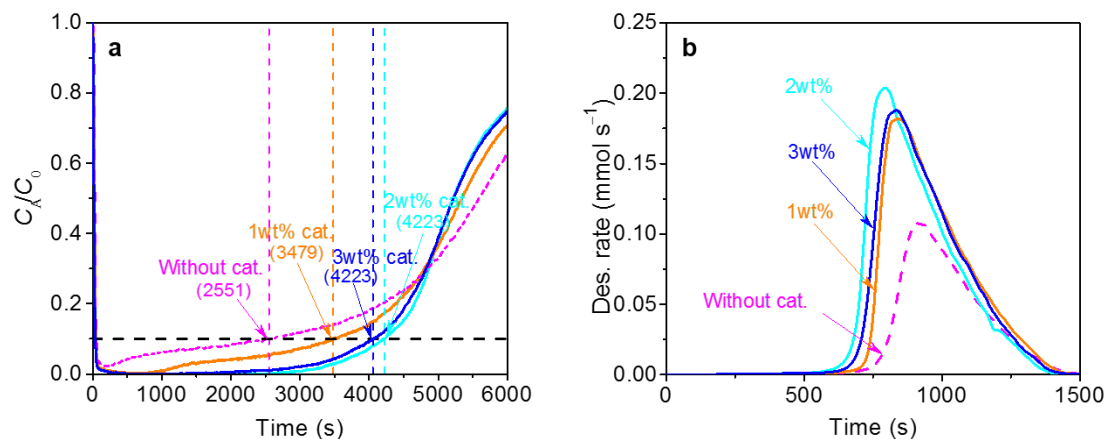
**Catalyst-TiO(OH)₂ could drastically reduce the energy consumption
of CO₂ capture**

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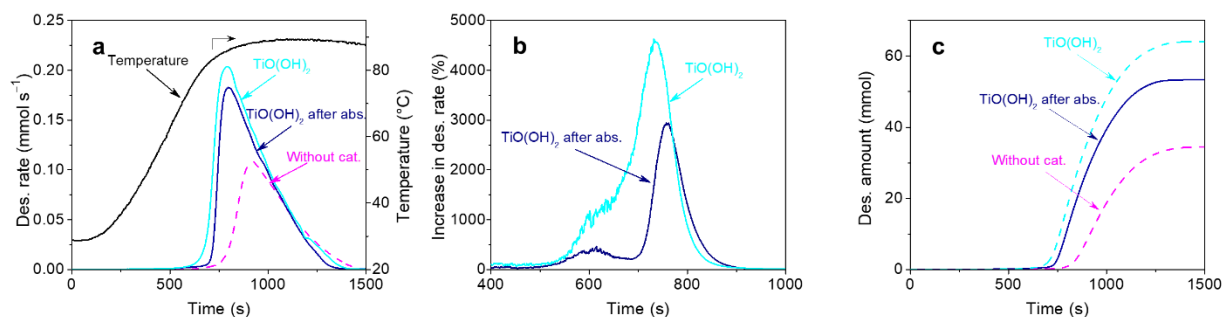
*Corresponding author. Email: mfan@uwyo.edu and mfan3@mail.gatech.edu.



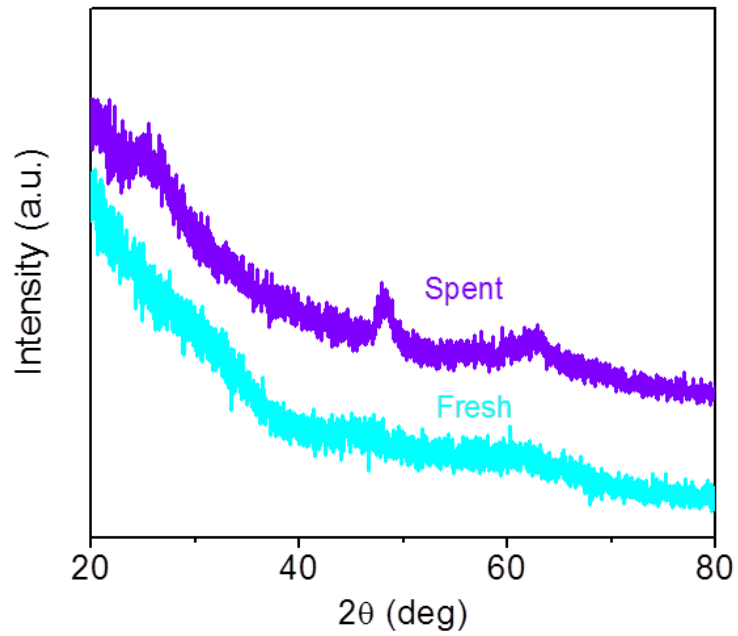
Supplementary Figure 1. Schematic drawing of MEA CO₂ absorption/desorption experimental setup. 1, 1, 1'': gas cylinders; 2: filter; 3: mass flow controller; 4: mass flow controller control module; 5: furnace; 6: thermostatic water bath; 7: catalyst suspended in the solvent; 8: muffle for inlet gas; 9: thermocouple; 10: mechanical stirrer; 11: condenser; 12: moisture remover; 13: cooling unit; 14: gas analyzer; 15: data recorder; 16: computer.



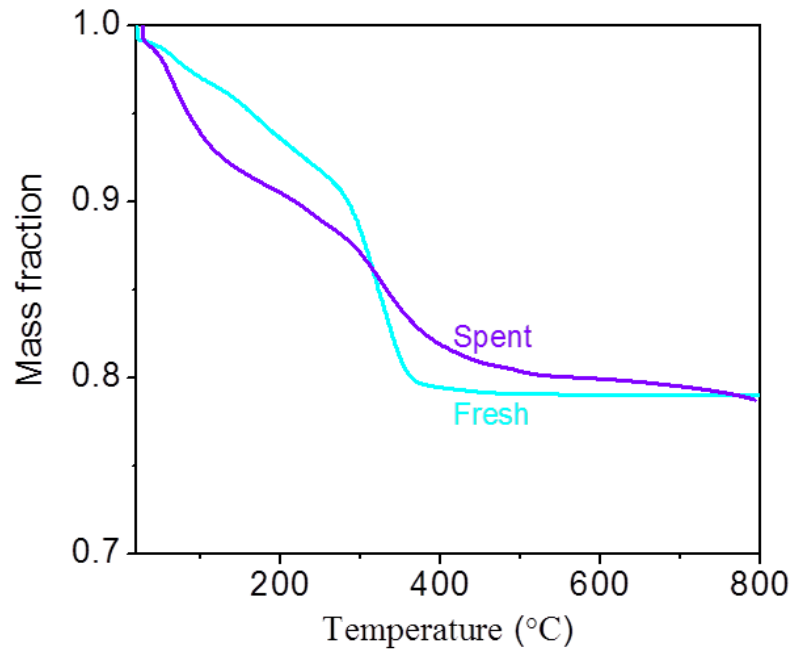
Supplementary Figure 2. Effect of $\text{TiO}(\text{OH})_2$ catalyst (cat.) concentration on uncatalyzed and catalyzed CO_2 absorption (abs.) and desorption (des.). **a** CO_2 absorption profiles of 20 wt% MEA sorbent. **b** CO_2 desorption rate of spent 20 wt% MEA sorbent.



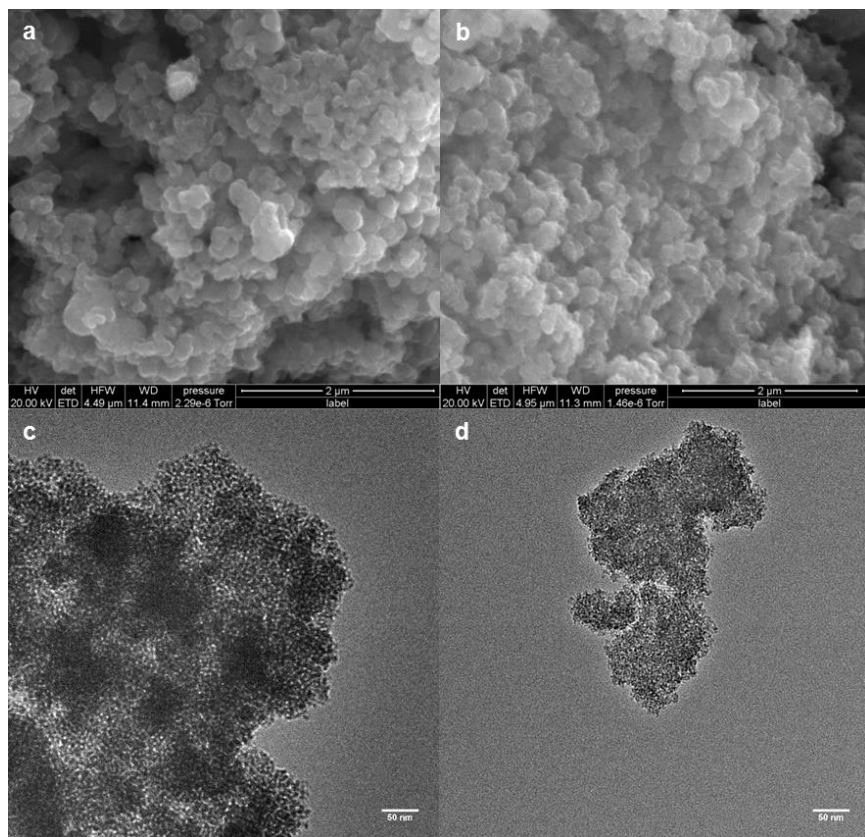
Supplementary Figure 3. Effect of addition of $\text{TiO}(\text{OH})_2$ before and after absorption step on catalyzed CO_2 desorption. **a** The rates of CO_2 desorption from spent 20 wt% MEA sorbent without and with addition of $\text{TiO}(\text{OH})_2$ before and after absorption step. **b** The percentage increases in CO_2 desorption rate due to the addition of $\text{TiO}(\text{OH})_2$ before and after absorption step. **c** Effects of addition of $\text{TiO}(\text{OH})_2$ before and after absorption step on the quantities of desorbed CO_2 .



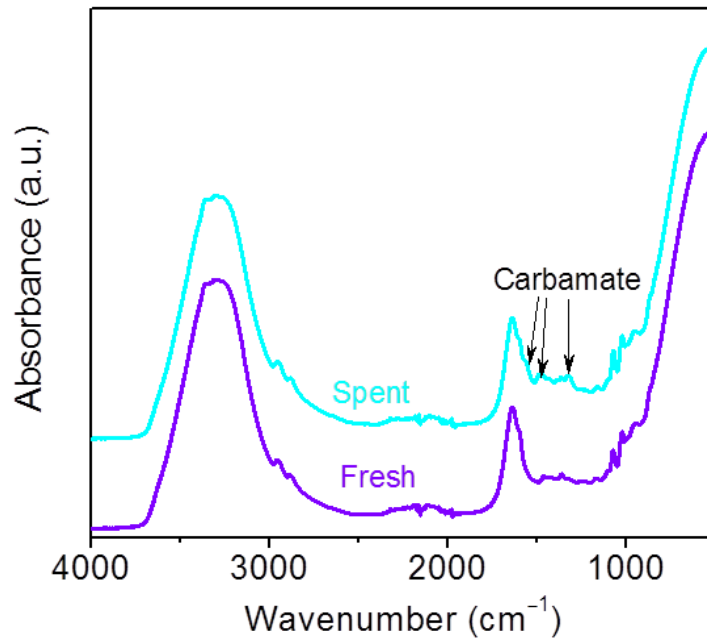
Supplementary Figure 4. XRD results of the fresh and used $\text{TiO}(\text{OH})_2$.



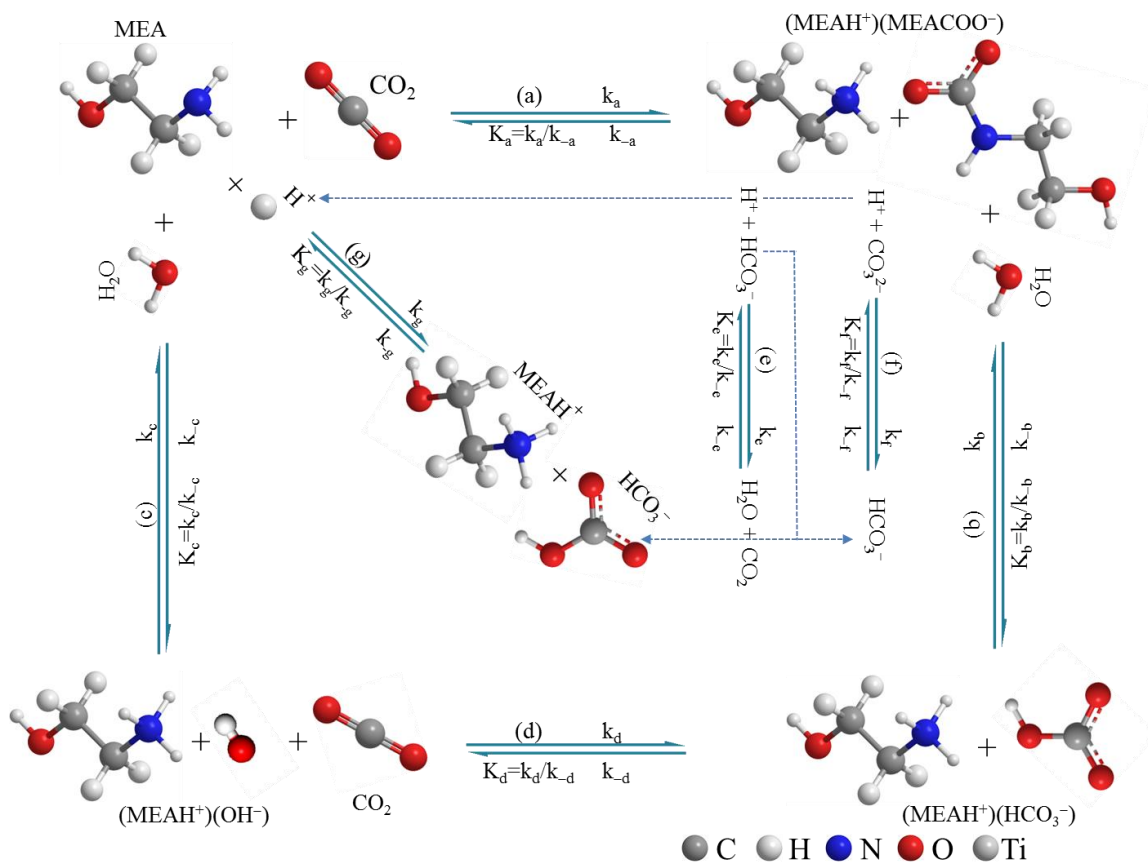
Supplementary Figure 5. TGA profiles of fresh and used $\text{TiO}(\text{OH})_2$.



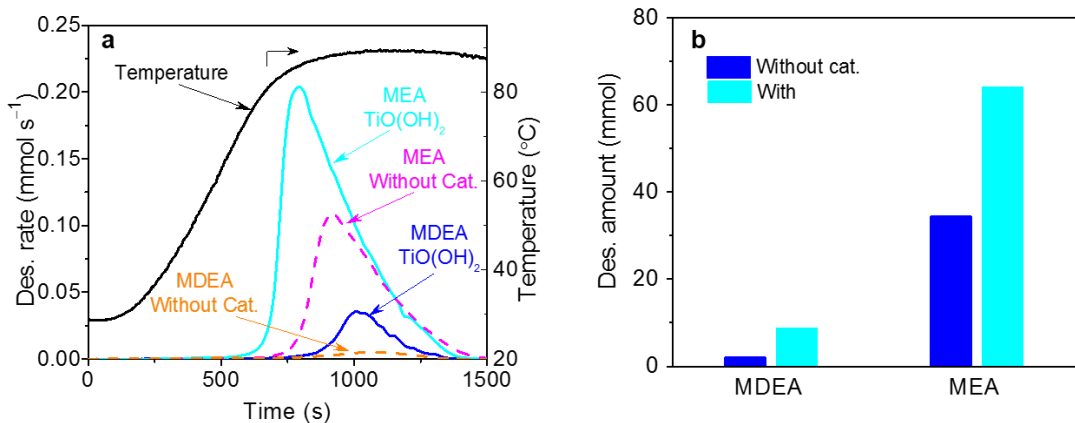
Supplementary Figure 6. Morphologies of fresh and used TiO(OH)_2 . **a** SEM images of fresh and **b** used TiO(OH)_2 . **c** TEM images of fresh and **d** used TiO(OH)_2 .



Supplementary Figure 7. FT-IR spectra of fresh and spent MEA sorbents.



Supplementary Figure 8. Reaction pathways for uncatalyzed CO₂ absorption and desorption with MEA solution.



Supplementary Figure 9. CO₂ desorption amount of different 20 wt% amine-based sorbents with and without TiO(OH)₂. **a** CO₂ desorption rate. **b** CO₂ desorption amount.

Supplementary Table 1. Desorption rate, time, and temperature at maximum CO₂ desorption point.

MEA solvents	Maximum CO ₂ des. rate (mmol s ⁻¹)	Time at maximum CO ₂ des. rate (s)	Temperature at maximum CO ₂ des. rate (°C)
Without Cat.	0.109	940	88.2
With TiO ₂	0.107	898	88.0
With silica gel	0.133	910	88.2
With HZSM-5	0.133	839	87.0
With TiO(OH) ₂	0.204	792	85.8
Add TiO(OH) ₂ after abs.	0.183	797	85.8

Supplementary Table 2. CO₂ loading before and after desorption step.

MEA solvents	CO ₂ loading after ads. step (mol CO ₂ mol ⁻¹ MEA)	CO ₂ loading after des. step (mol CO ₂ mol ⁻¹ MEA)	sorbent cyclic capacity (mol CO ₂ mol ⁻¹ MEA)
Without Cat.	0.520	0.467	0.0527
With TiO ₂	0.519	0.469	0.0497
With silica gel	0.518	0.462	0.0563
With HZSM-5	0.522	0.462	0.0599
With TiO(OH) ₂	0.541	0.443	0.0979
Add TiO(OH) ₂ after abs.	0.520	0.438	0.0817

Supplementary Table 3. BET analysis results of fresh and used TiO(OH)₂.

Samples	Specific surface area (m ² g ⁻¹)	Pore volume (cm ³ g ⁻¹)	Pore diameter (Å)
Fresh TiO(OH) ₂	783.2	0.573	17.1
HZSM-5	580.6	0.122	19.1
TiO ₂	48.44	0.084	15.3
Silica gel	532.8	0.760	24.4