

Supplementary materials

Capturing and Converting CO₂ using Amino Acids as Various Commercially Valuable Nano-carbonates

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S.1. Method to determine carbamate, Gly/Gly⁻, and HCO₃⁻/CO₃²⁻ in the system using Gly as amino acid

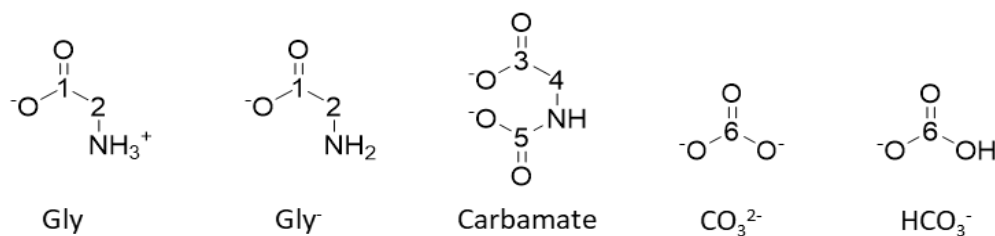


Figure S1. Numerical labeling of each carbon atom in carbamate, Gly/Gly⁻, and HCO₃⁻/CO₃²⁻.

¹³C NMR spectroscopy provides a means to quantify the concentration of each chemical species in the solvent, based on the area of the respective NMR peaks. In our solvent system, Gly/Gly⁻ can only transform into carbamate. Peaks 4 and 2 were selected to represent carbamate and Gly/Gly⁻, respectively. Equations below were used to describe the carbamate and Gly/Gly⁻.¹⁻³

$$\text{Carbamate (\%)} = \frac{\text{area of peak 4}}{\text{area of peak 2} + \text{area of peak 4}} \times 100\%$$

$$\text{Carbamate (mol)} = \text{Carbamate percentage} \times \text{Gly dosage}$$

$$\text{Gly/Gly}^{-} (\%) = 100 - \text{Carbamate}(\%)$$

S.2. Phase separation of nano-CaCO₃

0.05 mol Gly and 0.05 mol NaOH were mixed in 25 mL pure water used as a solvent. Subsequently, CO₂ gas was bubbled through the solvent for 20 min at a flow rate of 100 sccm. Next, 0.05 mol CaCl₂ was introduced into the solvent and vortexed for 1 min. After that, the sample was left to stand for 24 h.

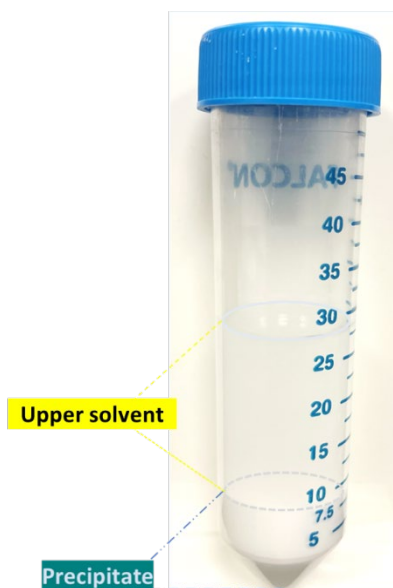


Figure S2. Phase separation after CaCl_2 was added.

S.3. SEM images of CaCO_3 of different magnifications and samples

The particles in **Fig. S2** were observed using SEM after washing and centrifugation. The SEM images (**Fig. S3**) were used for size distribution estimation.

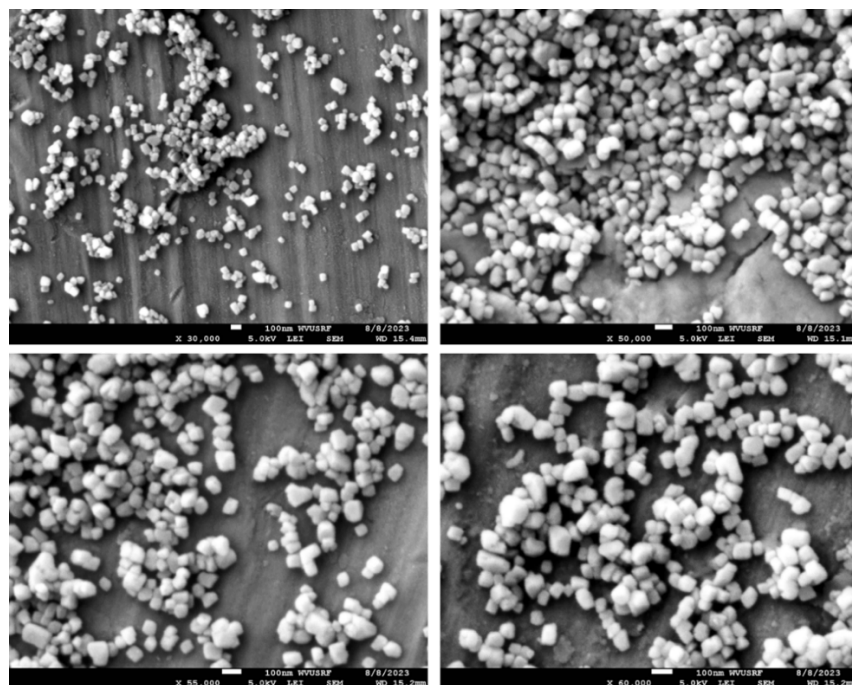


Figure S3. SEM images of different magnifications and samples.

S.4. SEM images of CaCO_3 produced by different amino acid with the dosage of 0.025 mol

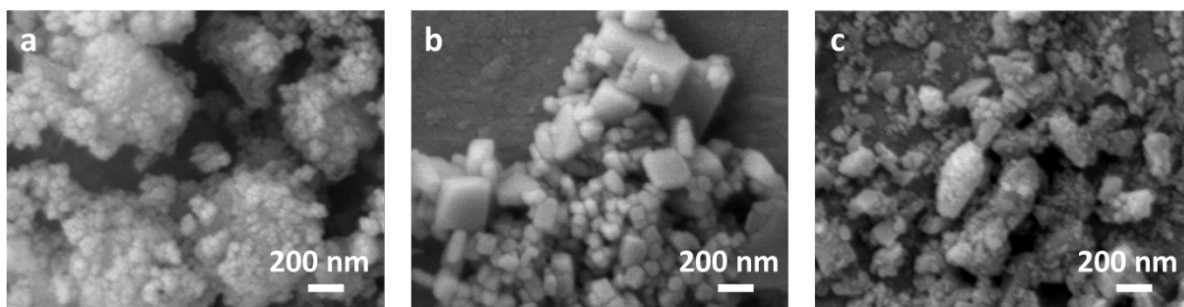
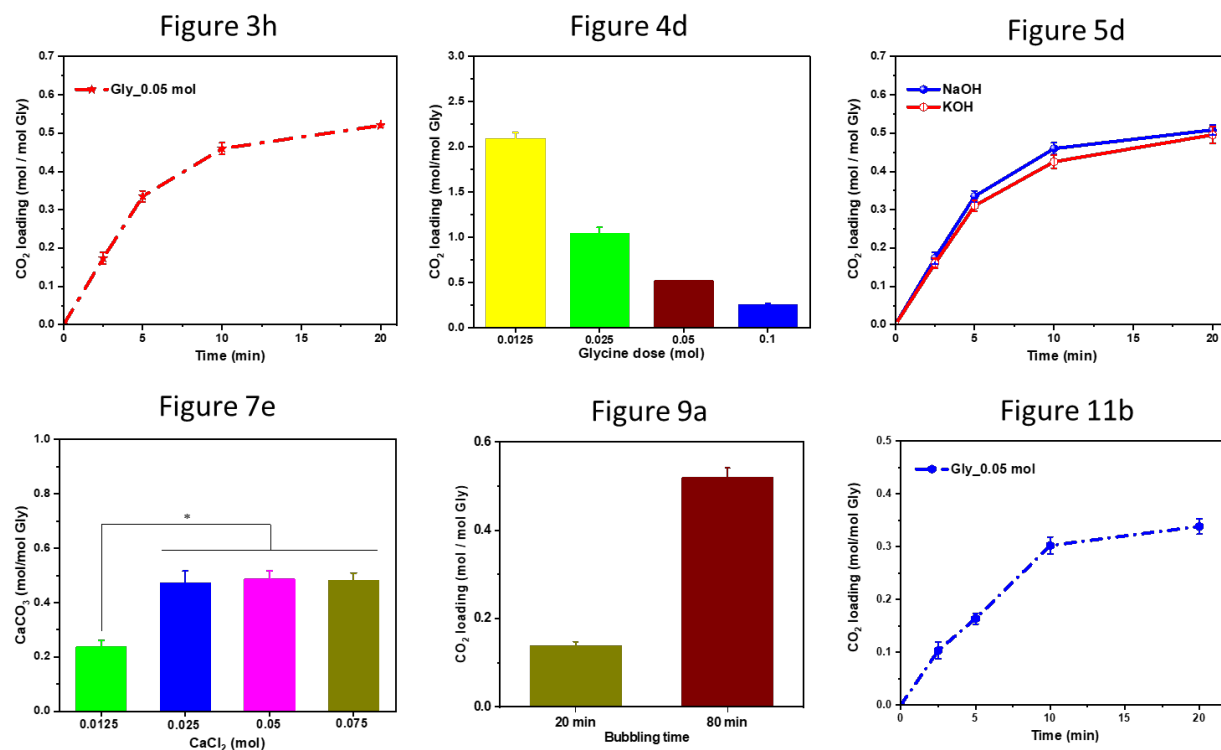


Figure S4. CaCO_3 prepared from a) Asn, b) Ala, and c) Cys with the dosage of 0.025 mol. Experimental conditions: Asn (0.025 mol), Ala (0.025 mol), Cys (0.025 mol), NaOH (0.05 mol), CaCl_2 (0.05 mol), CO_2 gas flow rate (100 sccm), and CO_2 bubbling time (20 min).

S.5. CO_2 loading CaCO_3 conversion based upon Gly concentration



Reference

- [1] Z. Bao, Q. Li, N.G. Akhmedov, B.A. Li, M. Xing, J. Wang, B.I. Morsi, B. Li, Innovative cycling reaction mechanisms of CO₂ absorption in amino acid salt solvents, *Chem. Eng. J. Adv.* (2022) 100250. <https://doi.org/https://doi.org/10.1016/j.cej.2022.100250>.
- [2] Q. Li, Z. Bao, N.G. Akhmedov, B.A. Li, Y. Duan, M. Xing, J. Wang, B.I. Morsi, B. Li, Unraveling the Role of Glycine in K₂CO₃ Solvent for CO₂ Removal, *Ind. Eng. Chem. Res.* 61(34) (2022) 12545-12554. <https://doi.org/https://doi.org/10.1021/acs.iecr.2c01637>.
- [3] X. Wang, N.G. Akhmedov, D. Hopkinson, J. Hoffman, Y. Duan, A. Egbeki, K. Resnik, B. Li, Phase change amino acid salt separates into CO₂-rich and CO₂-lean phases upon interacting with CO₂, *Appl. Energy* 161 (2016) 41-47. <https://doi.org/10.1016/j.apenergy.2015.09.094>.