

Supporting Information

**Recyclable carbon nanotube/silicone oil emulsion with NaOH aqueous solution for
indoor CO₂ capture**

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Table S1 Manufacturing conditions of lipophilic reinforcement surface functionalized CNTs.

| Content | Specifications |
|------------------|--|
| Nanoparticle | MWCNT Diameter: 5-20 nm, Length: ~10 μm Aspect ratio: >500 Purity: >90 wt% Specific surface area (BET): 130-160 m ² g ⁻¹ |
| Surfactant | Trimethoxy(octadecyl)silane (13 wt% to CNT) 3-aminopropyltriethoxysilane (2.5 wt% to CNT) Butylamine (2 wt% to CNT) |
| Base fluid | 2-Propanol |
| Ultrasonicator | 20 kHz, 750W, 30 min. |
| Magnetic stirrer | 400 rpm |
| Centrifuge | 6000 rpm, 30 min. |
| Vacuum oven | 80 °C, 24 hrs. |

Table S2 Manufacturing conditions of the materials.

| Step | Equipment | Condition |
|------|------------------|--------------------------------------|
| 1 | Magnetic stirrer | 200 rpm |
| | Ultrasonicator | 20 kHz, 750W, 1 h. |
| 2 | Magnetic stirrer | 200 rpm |
| | Water bath | Cooling capacity 880 W, 25 °C, 5 lpm |
| 3 | Magnetic stirrer | 200 rpm |
| | Ultrasonicator | 20 kHz, 750W, 30 min. |
| | Vacuum oven | -0.5 bar, 80 °C, 2 hrs. |

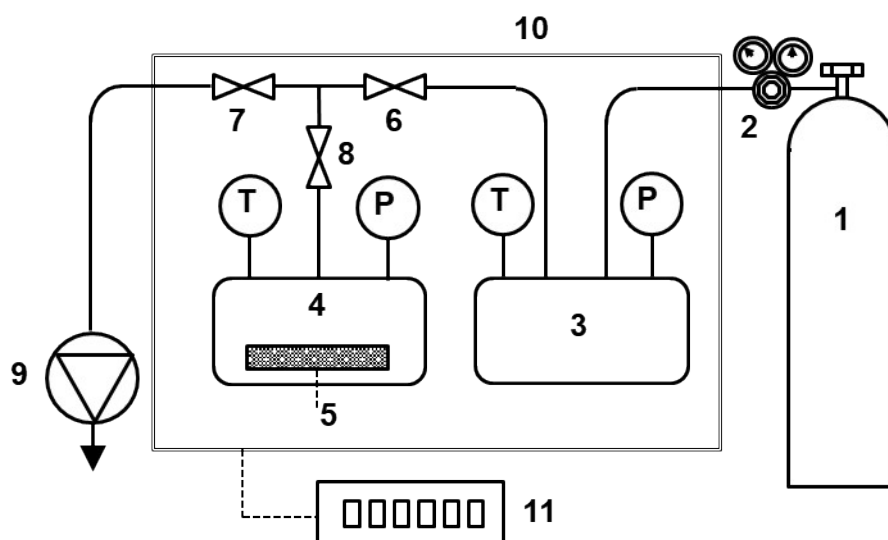


Fig. S1 Apparatus of the CO₂ capture experiment under pure CO₂ condition; 1: CO₂ gas, 2: Pressure regulator, 3: CO₂ reservoir tank, 4: CO₂ capture chamber, 5: Evaluation sample, 6: Valve-1, 7: Valve-2, 8: Valve-3, 9: Vacuum pump, 10: Thermostat, 11: Data acquisition device

Table S3 Specifications of the measuring devices.

| | Type | Range | Error |
|-------------|---------------------|---------------------------------------|-------------------------|
| Temperature | RTD | -50 ~ 250 °C | ±0.1K |
| Pressure | Pressure transducer | 0 ~ 5 bar | ±0.5% of the full scale |
| Volume | Digital caliper | 0 ~ 200 mm | ±0.01 mm |
| Weight | Electricity balance | 0 ~ 2000 g | ±2.0 mg |
| Vacuum pump | - | Open flow: 60 lpm Vacuum: 740 mmHg | - |

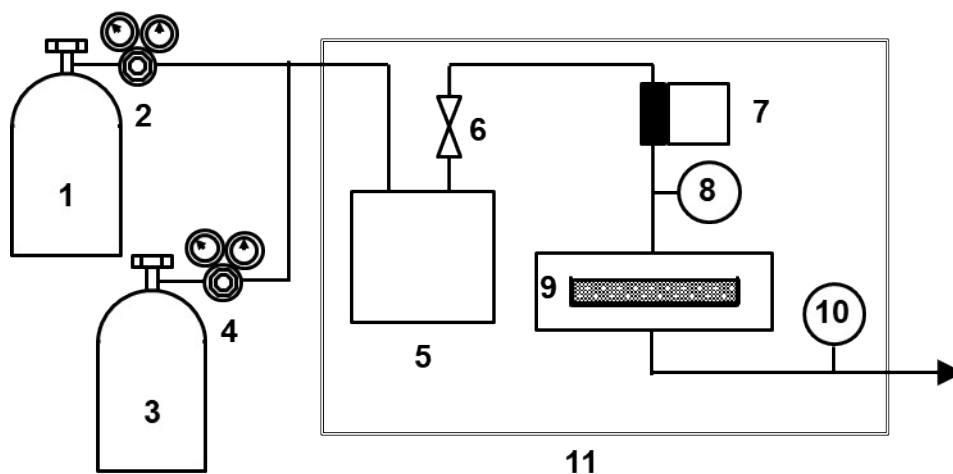


Fig. S2 Apparatus of the CO₂ capture experiment under low concentration CO₂ condition; 1: CO₂ gas, 2: Pressure regulator, 3: N₂ gas, 4: Pressure regulator, 5: humidity control chamber, 6: flow rate controller, 7: flow rate meter, 8: inlet gas analyzer, 9: Evaluation sample, 10: outlet gas analyzer, 11: Thermostat.

Table S4 Specifications of the measuring devices.

| | Type | Range | Error |
|-----------------|---------------------|-------------|-------------------|
| Temperature | RTD | -50-250 °C | ±0.1K |
| Humidity | Humidity transducer | 0.1-99.9% | ±0.1% |
| Flow rate | Mass flow rate | 0 ~ 10 lpm | ±1% of full scale |
| CO ₂ | Gas analyzer | 0-10000 ppm | ±50 ppm |
| Weight | Electricity balance | 0-2000 g | ±2.0 mg |

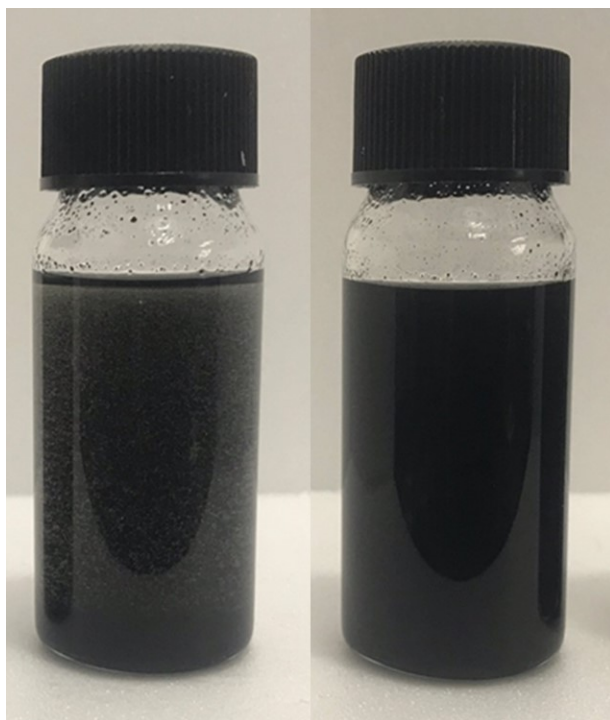


Fig. S3 Visualization of the dispersion in silicone oil according to the CNT type (left: pristine CNT and right: lipophilically reinforced CNT).

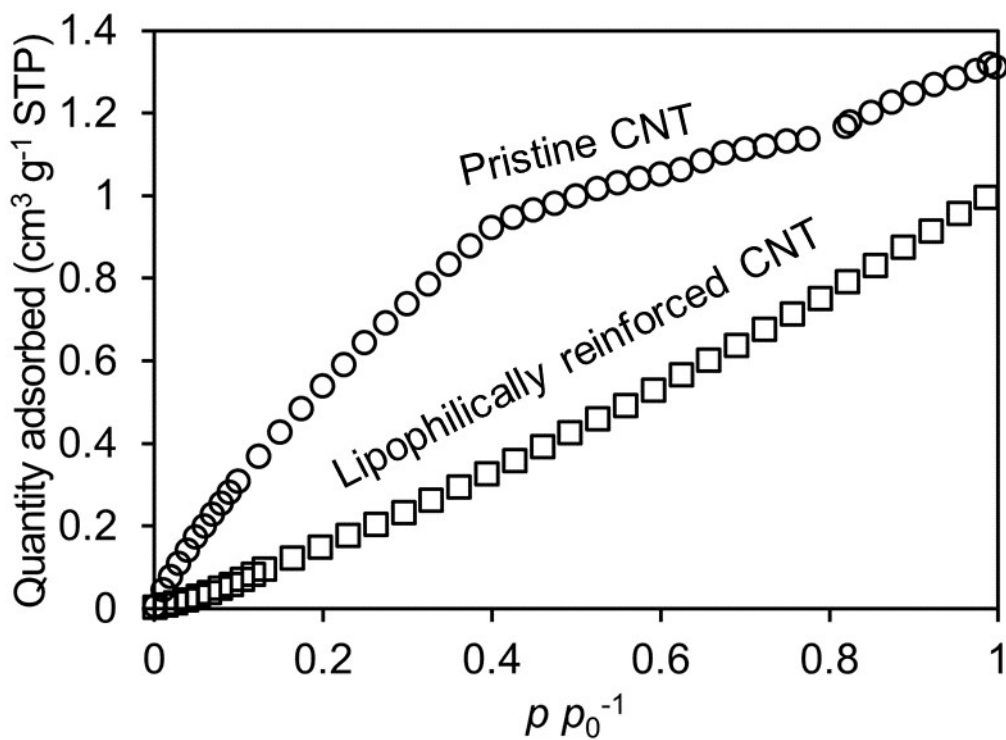


Fig. S4 CO₂ adsorption capacity according to the CNT type.

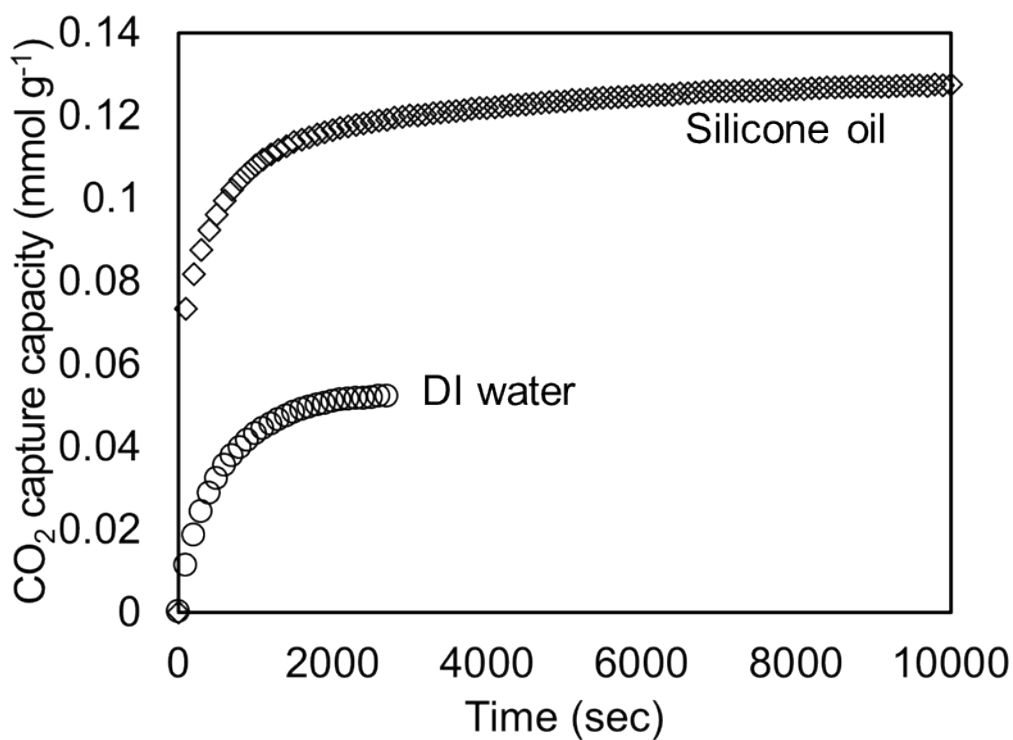


Fig. S5 CO₂ capture capacity of the silicone oil and the DI water.

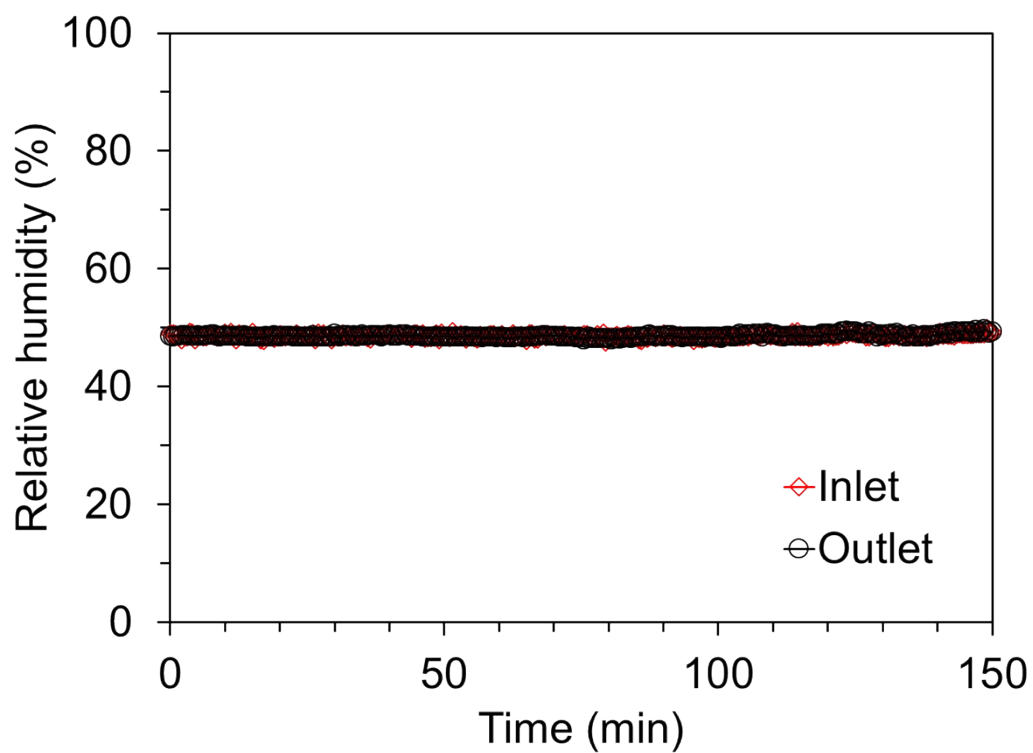


Fig. S6 Relative humidity variation at the inlet and outlet at 50% RH.

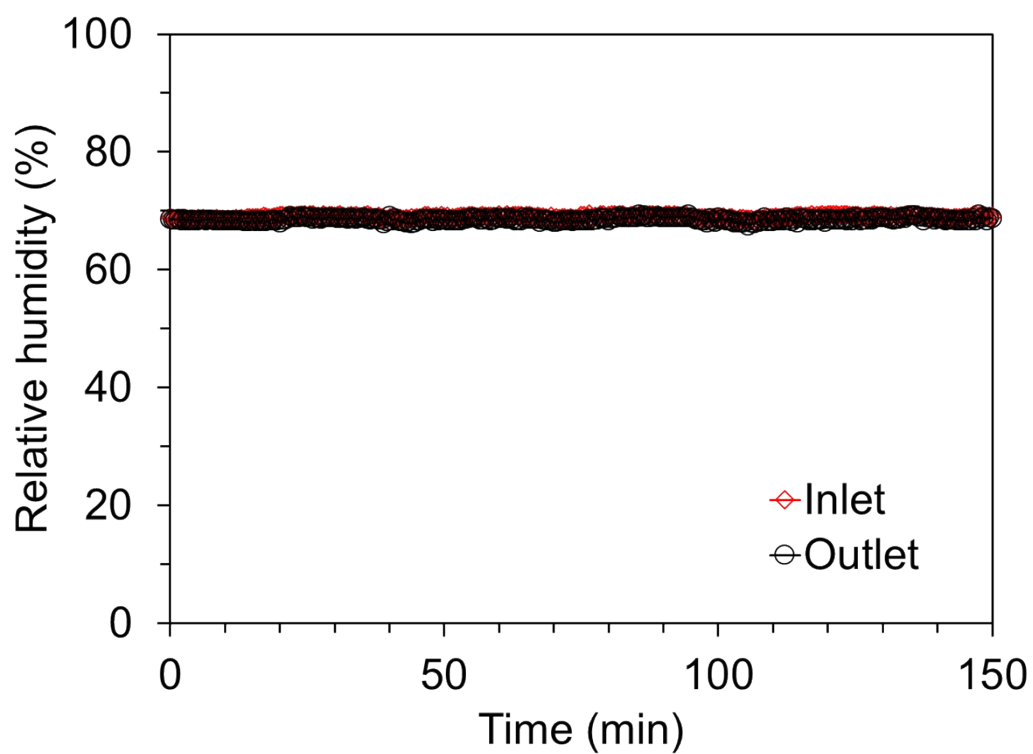


Fig. S7 Relative humidity variation at the inlet and outlet at 70% RH.

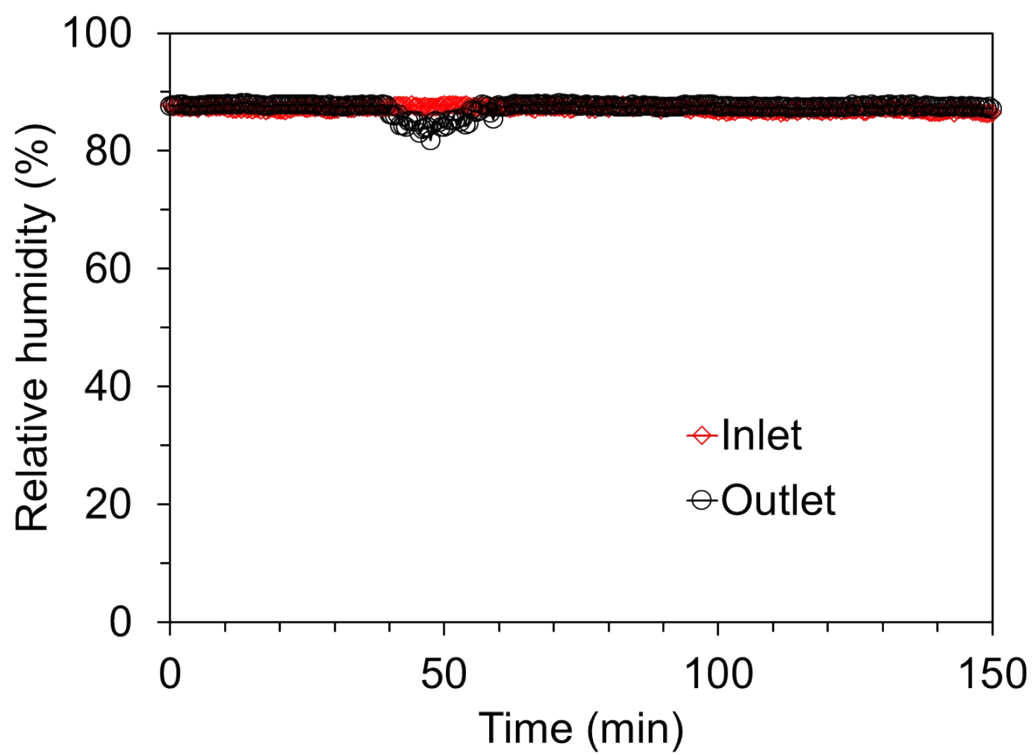


Fig. S8 Relative humidity variation at the inlet and outlet at 90% RH.

Table S5 Net material cost and ratio to fabricate 1 ton of ES-NaOH (CNT: 0.075 wt%).

| | Material | Price [USD ^{a)}] | Ratio [%] | |
|-------------|--------------------------------|----------------------------|-----------|-------|
| Oil phase | MWCNT (0.075 wt%) | 2,271 | 22.0 | 100.0 |
| | 2-propanol | 3,253 | 31.5 | |
| | Trimethoxy (octadecyl) silane | 630 | 6.1 | |
| | (3-Aminopropyl)triethoxysilane | 20 | 0.2 | |
| | Butylamine | 3 | 0.0 | |
| | Silicone oil | 41,445 | 40.1 | |
| Water phase | NaOH (30 wt%) | 4 | 0.0 | 0.0 |

^{a)} 1 USD (United States dollar) = 1,100 KRW (Korean Won)