Supplementary Material

A Comprehensive Physicochemical Assessment on Cyclic Stability and High-Capacity CO_2 Sorption Performance in Amine-Tethered Polymeric Resin

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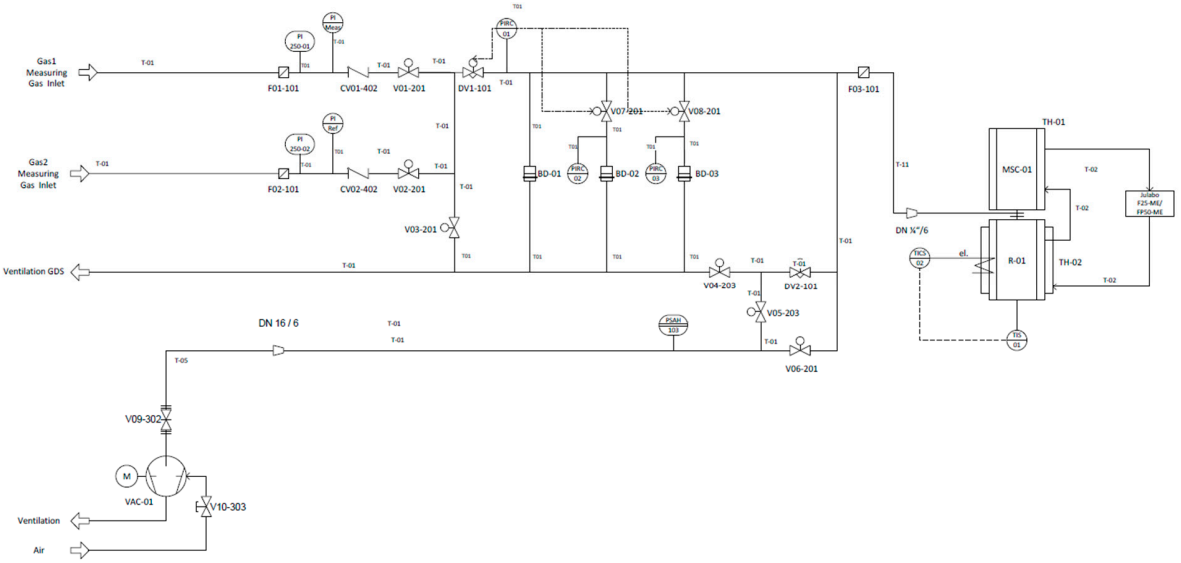


Figure S1. P&I diagram of IsoSORP (400-150,S-G) MSB.

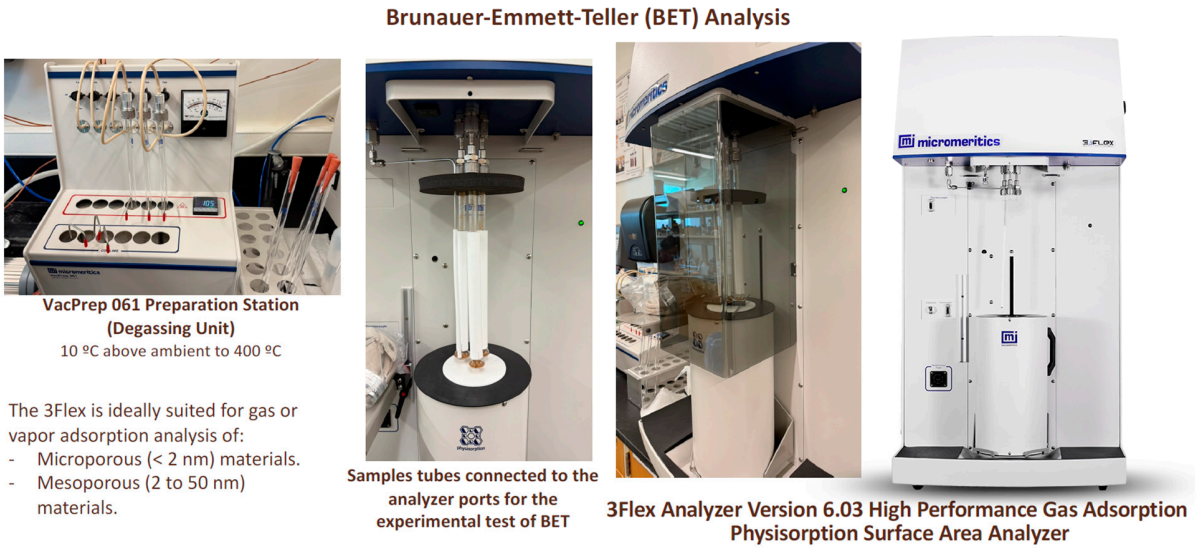


Figure S2. BET equipment in the lab.

Material Density:

Density of the material was calculated using RUBOTHERM magnetic suspension balance (MSB) system. The MSB has two measuring points (MP1) other than the off position and zero point position. The MP1 is to measure the mass of the sorbent to be as the first sample. After that, the calibrated volume titanium sinker is weighed as the second sample (MP2). Following Archimedes principle, the gas density is determined. These quantities are needed for the buoyancy correction of the measured sorption values. During the sorption experiments performance, the measured wight can be distorted by the buoyancy effect, which the lifting force applied by the fluid in the surrounding. This force becomes more significant when the fluid is dense, which happens at high pressure or low temperature. Due to this force, the apparent sample mass changes. So, it is needed to measure both sorption and fluid density at the same time. This way correctly calculate how much gas actually was adsorbed and how much mass change is due to the buoyancy. After the buoyancy measurements the balance reading is plotted as a function of the gas density and a straight line will appear with a negative slope as the figure S2 below.

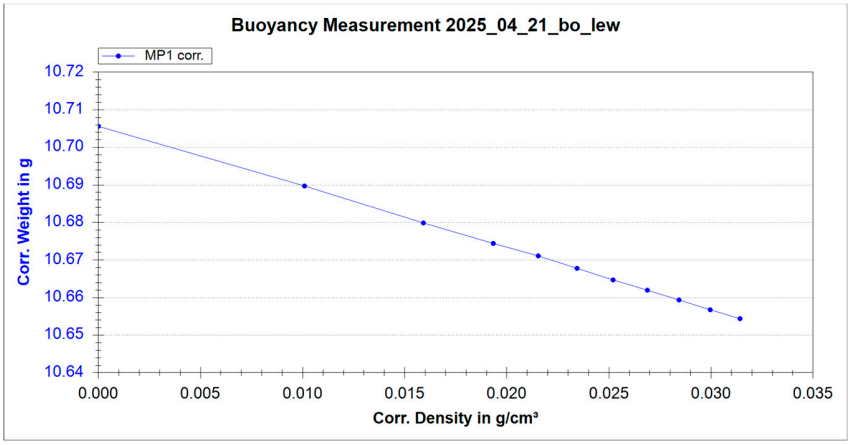


Figure S3. Buoyancy results example using He gas.

The calculation of the density follows the equations:

$$m_{BAL} = m_{SC+S} - \rho \cdot V_{SC+S}$$

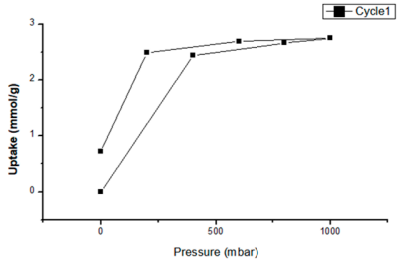
Where this equation is the equation of the fitted data and m_{BAL} is the balance reading m_{SC+S} is the mass of the sample container and the sample, ρ is the density and V_{SC+S} is the volume of the sample container and sample. Then you find the volume of the sample by the equation:

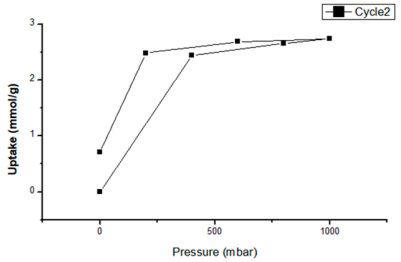
$$V_S = V_{SC+S} - V_{SC}$$

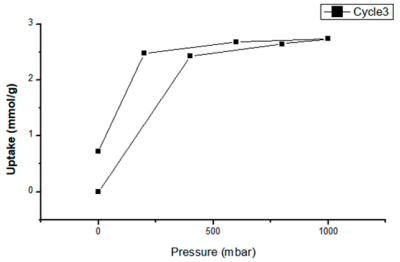
Where: V_S is the volume of the sample, V_{SC} is the sample container volume.
Sample mass is calculated by subtracting the sample container from the sum of sample container and sample as:

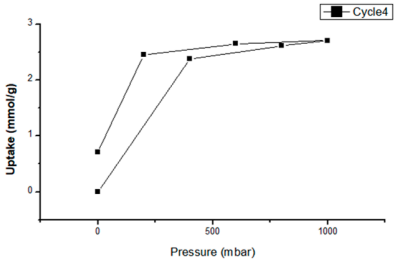
$$\mathbf{m_S = m_{SC+S} - m_{SC}}$$

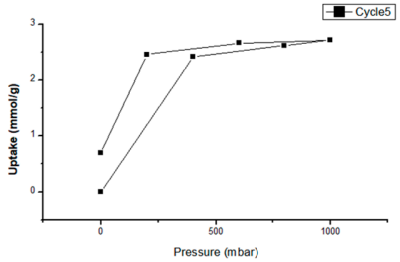
Then the sample density is the mass over the volume.

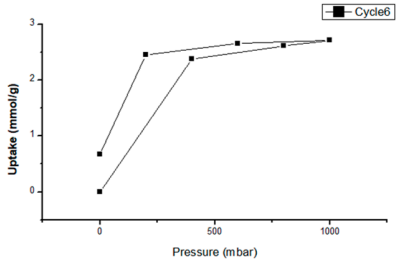

Cycle1
Uptake (mmol/g)
Pressure (mbar)

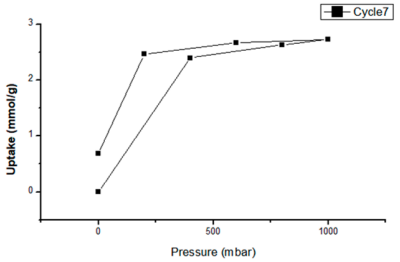

Cycle2
Uptake (mmol/g)
Pressure (mbar)

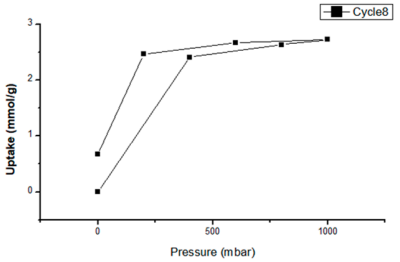

Cycle3
Uptake (mmol/g)
Pressure (mbar)

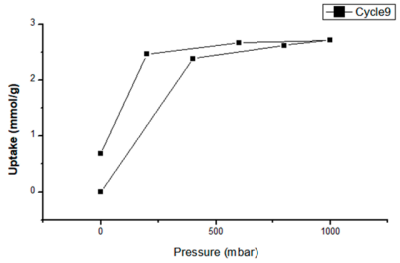

Cycle4
Uptake (mmol/g)
Pressure (mbar)

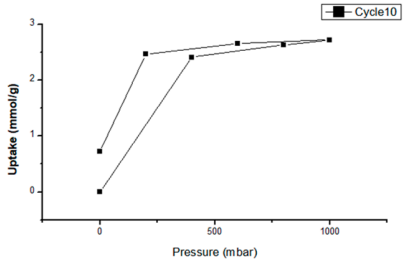

Cycle5
Uptake (mmol/g)
Pressure (mbar)

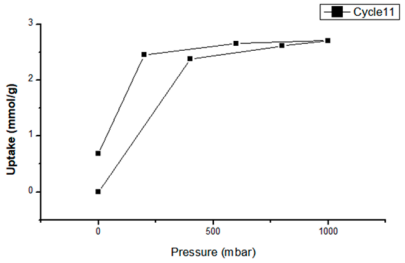

Cycle6
Uptake (mmol/g)
Pressure (mbar)

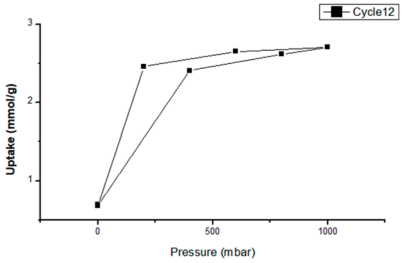

Cycle7
Uptake (mmol/g)
Pressure (mbar)

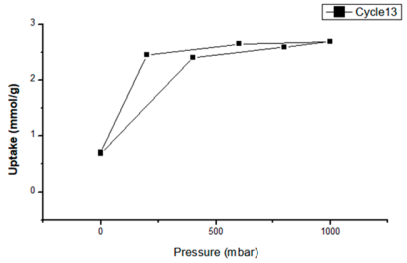

Cycle8
Uptake (mmol/g)
Pressure (mbar)

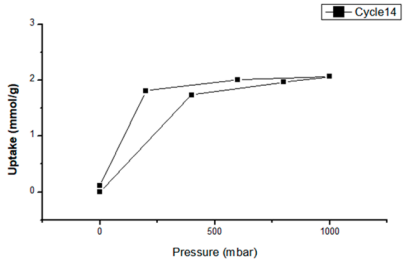

Cycle9
Uptake (mmol/g)
Pressure (mbar)

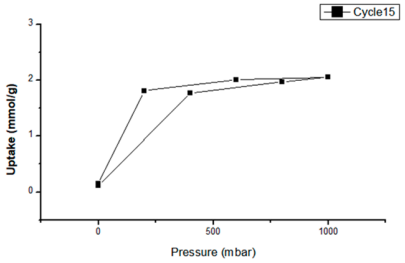

Cycle10
Uptake (mmol/g)
Pressure (mbar)

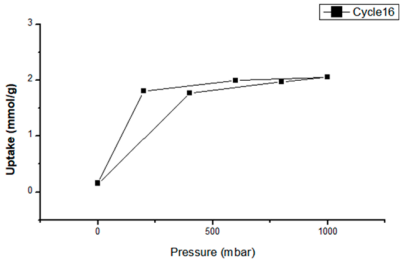

Cycle11
Uptake (mmol/g)
Pressure (mbar)

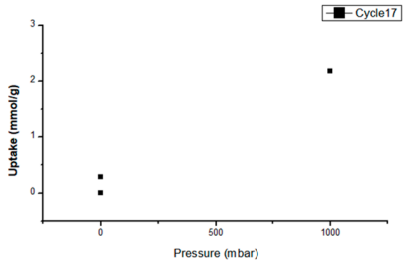

Cycle12
Uptake (mmol/g)
Pressure (mbar)

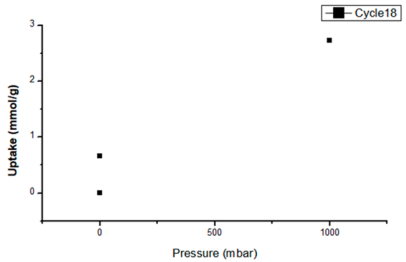

Cycle13
Uptake (mmol/g)
Pressure (mbar)

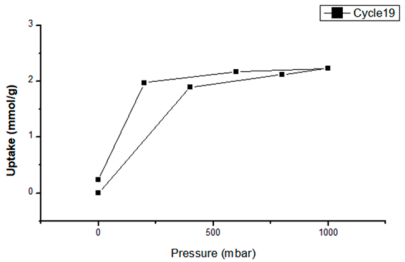

Cycle14
Uptake (mmol/g)
Pressure (mbar)


Cycle15
Uptake (mmol/g)
Pressure (mbar)


Cycle16
Uptake (mmol/g)
Pressure (mbar)


Cycle17
Uptake (mmol/g)
Pressure (mbar)


Cycle18
Uptake (mmol/g)
Pressure (mbar)


Cycle19
Uptake (mmol/g)
Pressure (mbar)

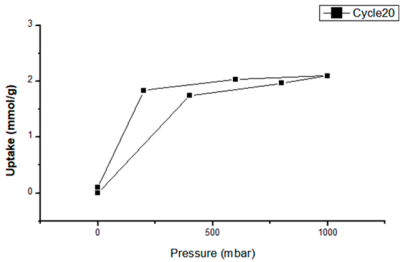

Cycle20
Uptake (mmol/g)
Pressure (mbar)

Figure S4. Cyclability test of adsorption-desorption of CO_2 by the tested material. Cycles 17 and 18 were dedicated for adsorption-desorption kinetics study of CO_2 gas in this material. For this reason, the measuring points were 0, 1000, and 0 mbar. Usually, kinetics analysis evaluates how much the process pace is. This helps to understand and optimize the scale up of the process.

Port #1

Isotherm Tabular Report

Relative Pressure (p/p°)	Absolute Pressure (mmHg)	Quantity Adsorbed (cm³/g STP)	Elapsed Time (h:min)	Saturation Pressure (mmHg)
			02:39	813.187927
0.090923034	74.030884	7.4012	03:02	814.214844
0.099585981	81.107742	7.5662	03:05	814.449402
0.149744913	121.988007	8.3128	03:08	814.638733
0.199961289	162.842377	8.9014	03:11	814.369507
0.250519615	204.021896	9.4121	03:14	814.394897
0.299911040	244.256271	9.8688	03:17	814.429077

Port #2

Isotherm Tabular Report

Relative Pressure (p/p°)	Absolute Pressure (mmHg)	Quantity Adsorbed (cm³/g STP)	Elapsed Time (h:min)	Saturation Pressure (mmHg)
			02:39	813.187927
0.085426734	69.562263	6.8557	03:03	814.291504
0.099403861	80.972260	7.1197	03:06	814.578613
0.150326213	122.458794	7.8799	03:10	814.620361
0.200483358	163.279831	8.4794	03:12	814.430847
0.249980129	203.666107	9.0006	03:15	814.729187
0.300174875	244.496429	9.4910	03:18	814.513306

Port #3

Isotherm Tabular Report

Relative Pressure (p/p°)	Absolute Pressure (mmHg)	Quantity Adsorbed (cm³/g STP)	Elapsed Time (h:min)	Saturation Pressure (mmHg)
			02:39	813.187927
0.091091581	74.174767	7.2013	03:04	814.287842
0.099695680	81.217903	7.3829	03:07	814.658203
0.150461171	122.522835	8.2125	03:10	814.315308
0.199812971	162.746994	8.8661	03:13	814.496643
0.250672437	204.166519	9.4614	03:16	814.475342
0.300339279	244.669769	10.0068	03:19	814.644592

Table S1. Isotherm tabular report of BET for the three ports.