CO_2 Capture with Physical Solvent Dimethyl Carbonate at High Pressures

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The constant-volume method is used to determine the solubility of CO_2 in dimethyl carbonate (DMC) under the pressure of 6 MPa and the temperature variations from (280.7 to 327.66) K in this paper. It is found by contrast that DMC has greater ability to dissolve CO_2 than propylene carbonate and methanol at the same temperature. Furthermore, the solubility of CO_2 in DMC at room temperature 298.47 K is close to that of methanol at 263.15 K. Therefore, DMC is expected to become an effective and low-cost absorbent for precombustion CO_2 capture.

Introduction

As a result of the worldwide rapid rising fossil fuel consumption, the amount of CO_2 in the atmosphere has increased very quickly in recent years, going up at a rate of about 2 ppm per year.[1] Since CO_2 is one of the main contributors to the greenhouse effect, the disposal of CO_2 emissions has become a key issue of global concern. It seems to be important to develop commercial fossil fuel conversion systems which could remove at least 90 % of CO_2 and keep the cost increase of electricity below 10 % by the year 2020.[2] One vision of such innovative clean energy is to develop the integrated gasification combined cycle (IGCC).[3]

IGCC combined with "Carbon dioxide Capture and Storage (CCS)" technology has attracted wide attention in the field of CO_2 emission reduction. As CO_2 is trapped before combustion under high pressure in IGCC, it could be better to use physical absorption[4] in the precombustion CO_2 capture. Utilization of high-solubility and low-cost absorbent for precombustion CO_2 capture can effectively reduce the electricity price increase caused by addition of a CO_2 removal unit. A large number of physical solvents have been developed, such as H_2O,[5–7] methanol,[8–11] propylene carbonate,[12,13] and polyethylene glycol dimethyl ether.[14,15] However, the performance of these solvents is not satisfied, and the costs of existing CO_2 capture technologies are still too high.

Dimethyl carbonate (DMC), a "green" absorbent, with advantages of high CO_2 loading, good selectivity, ecological compatibility, nonhazardous, nontoxic, chemical stability, and low vapor pressure,[16–19] is reasonably chosen as an absorbent in this study. The vapor−liquid equilibrium (VLE) experiments are performed in a high-pressure equilibrium cell, over a wide range of temperatures from (280.7 to 317.86) K and for the pressures of CO_2 up to 6 MPa. To verify the efficiency and advantage of DMC, a comparison of CO_2 solubility in DMC, propylene carbonate, and methanol was made in addition. The solubility data of CO_2 in DMC and propylene carbonate were measured in this study, while the data for methanol were taken from the literature.[20,21]

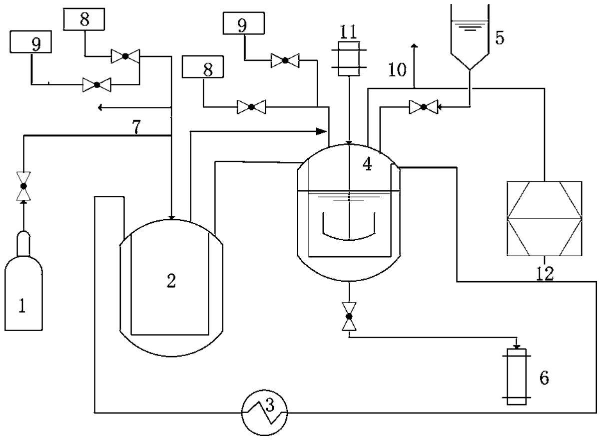

Figure 1. Schematic diagram of the apparatus: 1, CO_2 gas cylinder: 2, buffer tank; 3, water bath; 4, equilibrium cell; 5, liquid injector; 6, waste container; 7, vacuum connector; 8, digital pressure transducer; 9, digital temperature transducer; 10, vent valve; 11, magnetic stirrer; 12, computer.

Experimental Section

Materials. CO_2 with a volume fraction of 0.9999 was supplied by BeiWen Gas in Beijing. DMC ($C_3H_6O_3$, with a mass fraction of 0.999, made in China) and propylene carbonate ($C_4H_6O_3$, with a mass fraction of 0.999, made in China) were both obtained from Aladdin-Reagent Company in Shanghai. All components were used without further purification. The water used in the experiment was deionized water.

Apparatus and Experimental Procedures. Description of the Apparatus. A constant-volume method was used to determine the solubility of CO_2 in solvent, which was described in detail by Ning Ai.[22] To ensure the experiment accuracy, some modifications were made in this work, such as the improvements of heating system and simplifications of the pipeline system. Compared with other measure techniques, the constant-volume method can be used to measure the VLE data simply and precisely. Furthermore, the constant volume method can also avoid the accumulate errors caused by the decompression stage in the direct measurement.

Figure 1 shows a schematic diagram of the experimental apparatus used in this study. The whole apparatus was made in WeiHai YuanCheng Petroleum and Chemical Industry Equipment LTD in Shandong Province. Details of the experimental

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Table 1. Critical Temperature (T_C), Pressure (P_C), Compressibility Factor (Z_C), and Acentric Factor (ω) for CO_2, DMC, and Propylene Carbonate

compound	molecular formula	P_C MPa	T_C K	ω	Z_C
DMC	$C_3H_6O_3$	4.5[a]	548.0[a]	0.385[a]	0.248[a]
propylene carbonate	$C_4H_6O_3$	6.26	796.26	0.36	0.2585
CO_2	0.094[b]	7.383[b]	304.21[b]	0.225[b]	0.275[b]

[a] From ref 23. [b] From ref 24.

apparatus are given in Figure 1: a high-pressure equilibrium cell (GSH-250 mL/15 MPa) made of type 316 stainless steel; a buffer tank (FYG-250 mL/25 MPa) also made of type 316 stainless steel; and a heating system using a jacket which was connected to the circulating hot water source and analysis systems.

The equilibrium cell consists of the following parts: a cell body, a liquid injector made of glass, a liquid outlet, an inlet valve, a vent valve, two sample connections, a pressure transducer with an accuracy of ± 1 kPa, a resistance thermometer Pt-100 with an accuracy of ± 0.1 K, both connected by a digital indicator, and an anchor-type propelled agitator. The rotation speed is controlled by a variable-speed motor. The calibration was conducted for each sensor by the factory according to national standards without further calibration.

The buffer tank is a hermetically sealed container with two gas inlet valves, two gas outlet valves, a pressure transducer with an accuracy of ± 1 kPa, and a resistance thermometer Pt-100 with an accuracy of ± 0.1 K, and both sensors were also connected by a digital indicator.

Experimental Procedures. The gas leakage of the apparatus was checked before experiment. After a 24 h pressure maintaining test, the whole system was evacuated down to 7 kPa, and the computer began to record the temperature and pressure of the system continuously. When the gas pressures were stabilized within a few minutes, CO_2 gas was introduced into the buffer tank. At the same time, the temperature was set to a needed value by the water bath 3.

Then, 80 mL of solvent was injected into the equilibrium cell with the help of the vacuum inside the cell, and CO_2 gas was charged into the equilibrium cell from the buffer tank. After more than 1 h of stirring and standing for about another 1.5 h, a constant pressure reading was secured, and the system was considered to be at equilibrium. The equilibrium temperature (T) and pressure (p^E) were recorded, and the mole fraction of CO_2 in liquid phase at this pressure can be calculated from material balance, which was mentioned in the following data processing section. Then, the CO_2 partial pressure inside the equilibrium cell was increased to a higher pressure by introducing CO_2 gas again, and the $p-x$ curve can be obtained.

Results and Discussion

Pure Compound Properties. Experimental results for the phase equilibrium of CO_2 in DMC at high pressure are given as bellow. The molecular formula, critical temperature (T_C), critical pressure (P_C), critical compressibility factor (Z_C), and acentric factor (ω) for the three compounds are provided in Table 1.

Data Processing. The total amount of gas charged into equilibrium cell 4 is calculated from

$$\Delta n = n_1 - n_2 \tag{1}$$

where n_1 is the amount of gas in buffer tank 2 before the gas charging step and n_2 is the amount of gas in buffer tank 2 after the gas-charging step. When the system attained an equilibrium state, the absorbed amount of gas n_g is calculated from

$$n_g = \Delta n - n^i \tag{2}$$

After the equilibrium cell 4 is evacuated, the residual amount of gas n^i can be considered to be inert. The amount of solvent n_l added to equilibrium cell 4 is calculated from

$$n_l = \frac{\rho \Delta V}{M} \tag{3}$$

where ΔV is the volume of the solvent; ρ is the density of the solvent; and M is the mean molecular weight of the solvent.

Table 2. Mole Fraction (x_i), Partial Pressure (p), and Uncertainties (δ_i) of CO_2 in Water from (288.55 to 350.12) K

p/MPa	x_i	δ_i	p/MPa	x_i	δ_i
		$T = 288.55$ K			
0.0861	0.0004	0.0012	1.7011	0.0136	0.0011
0.2951	0.0024	0.0012	2.0061	0.0160	0.0010
0.5711	0.0046	0.0010	2.2141	0.0176	0.0010
0.7631	0.0061	0.0011	2.6221	0.0209	0.0011
0.9901	0.0079	0.0009	3.0021	0.0239	0.0009
1.2601	0.0100	0.0011	3.3741	0.0269	
1.4861	0.0118	0.0009			
		$T = 295.95$ K			
0.038	0.0002	0.0014	1.905	0.0122	0.0010
0.317	0.0020	0.0012	2.19	0.0140	0.0009
0.513	0.0031	0.0011	2.627	0.0169	0.0011
0.686	0.0043	0.0012	3.372	0.0216	0.0009
0.946	0.0061	0.0012	3.695	0.0236	0.0009
1.241	0.0079	0.0011	4.008	0.0255	0.0009
1.473	0.0094	0.0010	4.172	0.0267	0.0012
1.748	0.011	0.0009			
		$T = 301.35$ K			
0.1670	0.0009	0.0011	2.0350	0.0110	0.0011
0.4490	0.0024	0.0011	2.8810	0.0157	0.0009
0.5960	0.0033	0.0010	3.5430	0.0192	0.0012
0.7910	0.0043	0.0009	3.8760	0.0207	0.0009
1.1830	0.0064	0.0011	4.2720	0.0230	0.0011
1.5680	0.0085	0.0010	4.6050	0.0250	0.0009
1.8210	0.0099	0.0012	5.3130	0.0289	0.0011
		$T = 313.25$ K			
0.0560	0.0002	0.0010	2.8563	0.0118	0.0008
0.3740	0.0015	0.0010	3.3111	0.0136	0.0013
0.9150	0.0038	0.0009	3.7804	0.0156	0.0011
1.2301	0.0051	0.0009	4.4415	0.0181	0.0009
1.7822	0.0073	0.0010	4.9954	0.0206	0.0008
2.2789	0.0094	0.0009	5.4106	0.0223	0.0010
		$T = 324.05$ K			
0.3230	0.0011	0.0011	3.2357	0.0107	0.0010
0.7756	0.0026	0.0010	3.5722	0.0118	0.0008
1.2333	0.0041	0.0010	4.0570	0.0134	0.0011
1.7080	0.0057	0.0009	4.6730	0.0155	0.0009
1.8998	0.0066	0.0008	5.3209	0.0176	0.0010
2.6590	0.0088	0.0012	5.7831	0.0191	0.0009
		$T = 336.85$ K			
0.5503	0.00167	0.0010	3.6798	0.0100	0.0011
0.8850	0.0024	0.0009	4.167	0.0111	0.0011
1.3544	0.0036	0.0009	4.7830	0.0128	0.0008
1.8180	0.0048	0.0010	5.4311	0.0145	0.0009
2.0931	0.0056	0.0010	5.8932	0.0157	0.0008
2.7693	0.0074	0.0009	6.3090	0.0168	0.0008
3.3384	0.0089	0.0008			
		$T = 350.12$ K			
0.2901	0.0006	0.0010	3.475	0.0077	0.0012
0.4211	0.0009	0.0008	3.815	0.0085	0.0009
0.568	0.0013	0.0011	4.302	0.0095	0.0011
1.1102	0.0023	0.0009	4.918	0.0109	0.0009
1.475	0.0033	0.0010	5.566	0.0123	0.0008
1.953	0.0043	0.0009	6.028	0.0134	0.0012
2.228	0.0049	0.0008	6.444	0.0143	0.0008
2.904	0.0065	0.0012	3.475	0.0077	0.0009

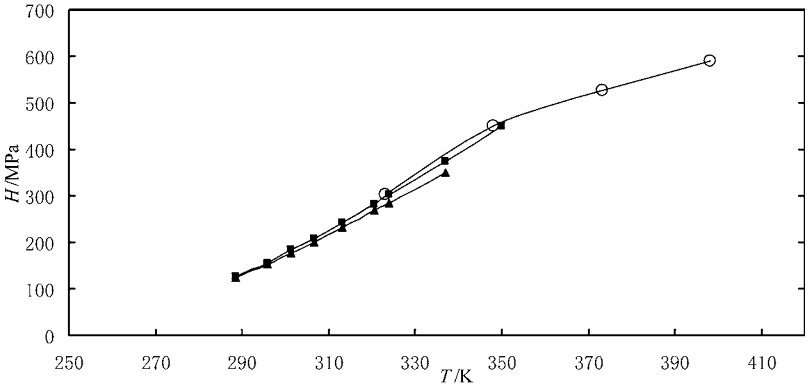

Figure 2. Henry's law constant of the CO_2 in water at high pressure from (288.55 to 350.12) K. *H* is Henry's law constant of the CO_2 in water: ▲, correlation of Carroll;[25] ■, this study; ○, Zawisza.[26]

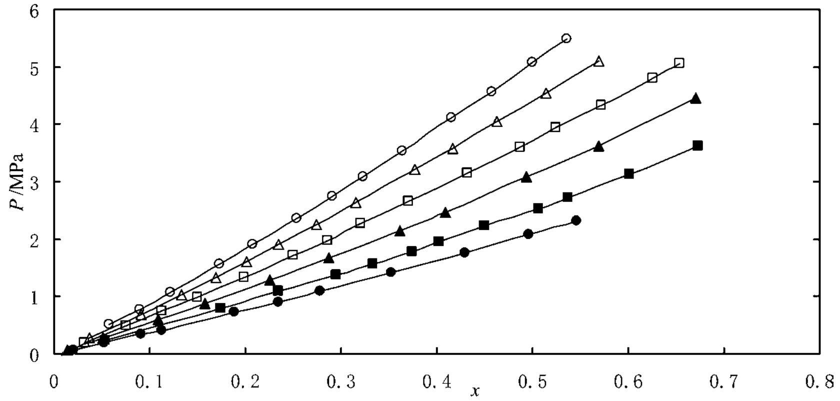

Figure 3. Vapor−liquid equilibrium of the CO_2 + DMC system in this study. *x* is the mole fraction of CO_2 in the liquid phase, and *p* is the partial pressure of CO_2 at the equilibrium state: ●, 280.7 K; ■, 289.49 K; ▲, 298.47 K; □, 307.84 K; △, 317.8 6K; ○, 327.66 K.

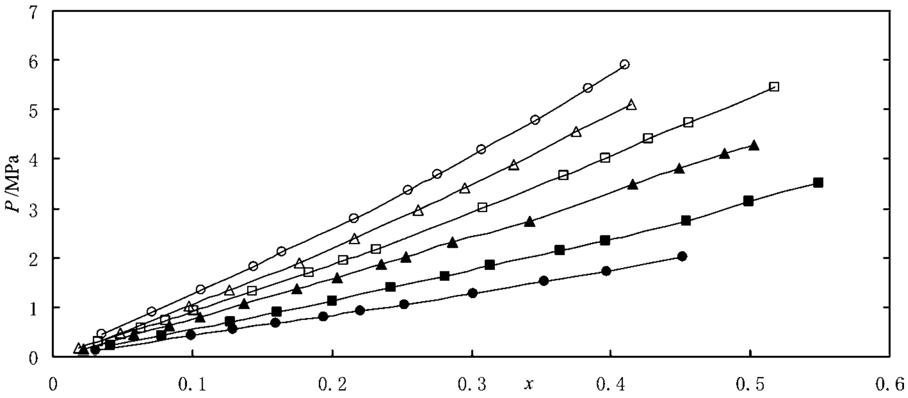

Figure 4. Vapor−liquid equilibrium of the CO_2 + propylene carbonate system in this study. *x* is the mole fraction of CO_2 in the liquid phase and *p* is the partial pressure of CO_2 at the equilibrium state: ●, 278.27 K; ■, 288.42 K; ▲, 297.81 K; □, 307.69 K; △, 317.65 K; ○, 327.66 K.

The solubility of CO_2 in the solvent expressed in mole fraction is calculated from

$$x = \frac{n_g}{n_g + n_l} \qquad (4)$$

Assume that the solvent follows Raoult's law, and then the equilibrium partial pressure can be calculated from

$$P_{CO_2} = P - P^S(1 - x) - P^i \qquad (5)$$

where *P* is the pressure inside the equilibrium cell 4 while phase equilibrium is being established; P^S is the saturated vapor pressure of the solvent at the equilibrium temperature; and P^i is the inert gas pressure.

n_1, n_2, and n^i are all calculated by the SRK equation of state from PVT data, and some correction for vapor-phase nonideality was included.

Reliability of Apparatus. The solubility of CO_2 in water was measured at high pressure to verify the reliability of the apparatus used in this study. In this paper, it is assumed that pressure has little effect on the value of Henry's law constant. The temperature *T*, the CO_2 partial pressure *p* at the equilibrium state, CO_2 mole fraction x_i in the liquid phase, and the estimated uncertainties δ_i for the binary systems $CO_2 + H_2O$ are presented in Table 2. As shown in Figure 2, the Henry's law constant from the experiments is in the range of (100 to 500) MPa. Compared with the literature data,[25,26] the deviations are in the allowable range (around 6 %)[27] which show the same trend with temperature as that in the literature. It means that the experi-

Table 3. Mole Fraction (x_i), Equilibrium Pressure (p), and Uncertainties (δ_i) of CO_2 in DMC from (280.7 to 327.66) K

p/MPa	x_i	δ_i	p/MPa	x_i	δ_i
T = 280.7 K					
0.0742	0.0209	0.0012	1.0921	0.2786	0.0011
0.1883	0.0528	0.0012	1.4123	0.3532	0.0010
0.3355	0.0912	0.0010	1.7476	0.4290	0.0010
0.4175	0.1123	0.0011	2.0778	0.4967	0.0011
0.7188	0.1883	0.0009	2.3099	0.5457	0.0009
0.9089	0.2351	0.0011			
T = 289.49 K					
0.2396	0.0539	0.0014	1.9413	0.4025	0.0010
0.8032	0.1738	0.0012	2.2316	0.4502	0.0009
1.1015	0.2346	0.0011	2.5228	0.5061	0.0011
1.3728	0.2955	0.0012	2.712	0.5374	0.0009
1.5630	0.3331	0.0012	3.1323	0.6015	0.0009
1.7752	0.3746	0.0011	3.6126	0.6734	0.0009
T = 298.47 K					
0.0736	0.0140	0.0011	2.1464	0.3615	0.0011
0.2799	0.0519	0.0011	2.4596	0.4091	0.0009
0.6015	0.1094	0.0010	3.0753	0.4942	0.0012
0.8768	0.1573	0.0009	3.6219	0.5688	0.0009
1.2793	0.2250	0.0011	4.4587	0.6701	0.0011
1.6698	0.2877	0.0010	.		
T = 307.84 K					
0.1947	0.0323	0.0010	2.6466	0.3703	0.0013
0.4832	0.0757	0.0010	3.1533	0.4322	0.0011
0.7395	0.1130	0.0009	3.6091	0.4866	0.0009
0.9909	0.1496	0.0009	3.9355	0.5248	0.0008
1.3327	0.1984	0.0010	4.3361	0.5719	0.0010
1.7133	0.2494	0.0009	4.8087	0.6254	0.0010
1.9816	0.2855	0.0008	5.0551	0.6536	0.0009
2.2641	0.3211	0.0008			
T = 317.86 K					
0.2770	0.0375	0.0011	2.6333	0.3155	0.0010
0.6840	0.0911	0.0010	3.2084	0.3763	0.0008
1.0298	0.1328	0.0010	3.5851	0.4170	0.0011
1.3335	0.1696	0.0009	4.0400	0.4626	0.0009
1.6121	0.2014	0.0008	4.5459	0.5138	0.0010
1.8987	0.2349	0.0012	5.1070	0.5698	0.0009
2.2465	0.2741	0.0011			
T = 327.66 K					
0.5057	0.0581	0.0010	3.0880	0.3236	0.0011
0.7814	0.0898	0.0009	3.5401	0.3647	0.0011
1.0773	0.1215	0.0009	4.1076	0.4160	0.0008
1.5649	0.1737	0.0010	4.5669	0.4580	0.0009
1.9119	0.2083	0.0010	5.070	0.4999	0.0008
2.3621	0.2540	0.0009	5.4761	0.5353	0.0008
2.7520	0.2908	0.0008			

mental method in this work is valid for the measurement of gas solubility at high pressure. Moreover, the possible error generated in this work can be decreased further by measuring the solubility of a solvent with high CO_2 loading.

The uncertainties of the measurement consist of system errors for temperature, pressure, and volume. The measurement errors of temperature, pressure, and volume are $u(T) = 0.1$ K, $u(P_1) = u(P_2) = 0.01$ MPa, $u(P^E) = 0.001$ MPa, and $u(V) = 0.05$ mL. According to the method of the estimation of uncertainties, the overall uncertainty for the measured solubility of CO_2 can be calculated from

$$\frac{u(x)}{x} = \sqrt{\left(\frac{u(n_g)}{n_g}\right)^2 + \left(\frac{u(n_g + n_l)}{n_g + n_l}\right)^2} = \sqrt{\frac{u(n_1)^2 + u(n_2)^2 + u(n^E)^2}{n_g^2} + \frac{u(n_1)^2 + u(n_2)^2 + u(n^E)^2 + u(n_l)^2}{(n_g + n_l)^2}} \qquad (6)$$

in which $u(n_1)$, $u(n_2)$, and $u(n^E)$ can be estimated by

Table 4. Mole Fraction (x_i), Equilibrium Pressure (p), and Uncertainties (δ_i) of CO_2 in Propylene Carbonate from (278.27 to 327.66) K

p/MPa	x_i	δ_i	p/MPa	x_i	δ_i
T = 278.27 K					
0.1201	0.0311	0.0006	1.0431	0.2522	0.0009
0.4111	0.0990	0.0005	1.2751	0.3017	0.0008
0.5391	0.1293	0.0005	1.5211	0.3526	0.0007
0.6641	0.1602	0.0004	1.7291	0.3970	0.0006
0.7961	0.1945	0.0004	2.0081	0.4517	0.0008
0.9121	0.2205	0.0003			
T = 288.42 K					
0.2161	0.0412	0.0005	1.8311	0.3138	0.0005
0.4251	0.0779	0.0004	2.1361	0.3638	0.0005
0.7011	0.1278	0.0004	2.3441	0.3960	0.0004
0.8931	0.1612	0.0003	2.7521	0.4539	0.0008
1.1201	0.2004	0.0003	3.1321	0.4993	0.0007
1.3901	0.2425	0.0007	3.5041	0.5491	0.0006
1.6161	0.2807	0.0006			
T = 297.81 K					
0.1591	0.0218	0.0003	2.0261	0.2529	0.0005
0.4381	0.0579	0.0003	2.3111	0.2860	0.0004
0.6341	0.0831	0.0002	2.7481	0.3414	0.0010
0.8071	0.1058	0.0002	3.4931	0.4159	0.0008
1.0671	0.1374	0.0007	3.8161	0.4489	0.0007
1.3621	0.1748	0.0006	4.1211	0.4813	0.0006
1.5941	0.2038	0.0006	4.2931	0.5025	0.0005
1.8691	0.2351	0.0005			
T = 307.69 K					
0.2981	0.0328	0.0002	3.0141	0.3082	0.0008
0.5801	0.0632	0.0002	3.6741	0.3663	0.0007
0.7301	0.0808	0.0002	4.0071	0.3962	0.0006
0.9211	0.1009	0.0001	4.4031	0.4273	0.0005
1.3141	0.1433	0.0004	4.7361	0.4560	0.0008
1.6991	0.1838	0.0004	5.4541	0.5170	0.0006
1.9521	0.2086	0.0003			
2.1661	0.2316	0.0003			
T = 317.65 K					
0.1671	0.0185	0.0003	2.9741	0.2615	0.0006
0.4851	0.0484	0.0003	3.4211	0.2948	0.0005
1.0261	0.0977	0.0002	3.8921	0.3301	0.0004
1.3411	0.1267	0.0002	4.5521	0.3749	0.0006
1.8911	0.1768	0.0007	5.1061	0.4147	0.0005
2.4011	0.2161	0.0006			
T = 327.66 K					
0.4450	0.0355	0.0004	3.6920	0.2758	0.0006
0.8970	0.0715	0.0003	4.1790	0.3070	0.0005
1.3520	0.1064	0.0003	4.7950	0.3465	0.0006
1.8300	0.1442	0.0002	5.4430	0.3842	0.0005
2.1050	0.1646	0.0002	5.9050	0.4100	0.0005
2.7810	0.2157	0.0007			
3.3520	0.2549	0.0006			

$$\frac{u(n_1)}{n_1} = \frac{1}{R}\sqrt{\left(\frac{u(P_1)}{P_1}\right)^2 + \left(\frac{u(V_1)}{V_1}\right)^2 + \left(\frac{u(T_1)}{T_1}\right)^2} \qquad (7)$$

and $u(n_l)$ is estimated by

$$u(n_l) = \frac{\rho}{M}u(V_l) \qquad (8)$$

The estimated uncertainties are also referred to in Table 3 and Table 4.

Results and Discussions. The temperature T, the CO_2 partial pressure p at the equilibrium state, the CO_2 mole fraction x_i in the liquid phase, and the estimated uncertainties δ_i for the binary systems CO_2 + DMC and CO_2 + propylene carbonate are presented in Table 3 and Table 4 and plotted in Figure 3 and Figure 4.

It can be seen in Table 3 and Figure 3 that the solubility of CO_2 in DMC decreases with increasing temperature and decreasing pressure. In this study, solubility data of CO_2 in DMC

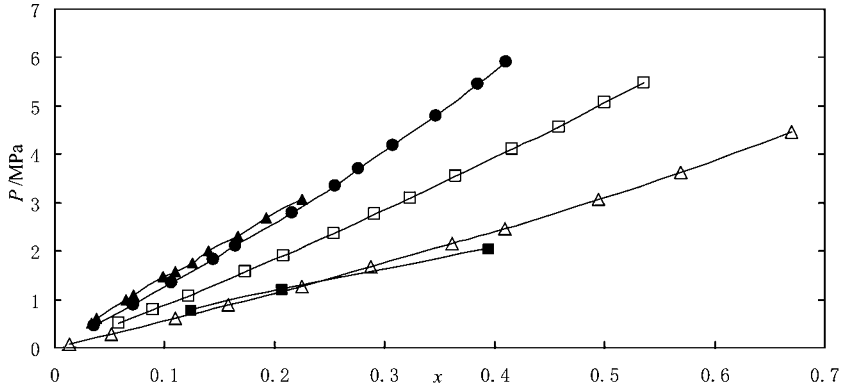

Figure 5. Comparison of CO_2 solubility in DMC, methanol, and propylene carbonate. x is the mole fraction of CO_2 in the liquid phase, and p is the partial pressure of CO_2 at equilibrium state: ●, propylene carbonate in this study, 327.66 K; □, DMC in this study, 327.66 K; ▲, methanol by Secuianu, 298.15 K;[20] ■, methanol by Joung, 263.15 K;[21] Δ, DMC in this study, 298.47 K.

Table 5. Henry's Law Constant of the CO_2 + DMC System from (280.7 to 327.66) K

	T/K	Henry's law constant/MPa
experiment	280.70	4.0958
	289.49	5.0377
	298.47	6.2758
	307.84	7.4536
	317.86	8.6316
	327.66	9.8571

at low pressure present good agreement with the literature data reported by Ai Ning,[28] and the relative error is in the allowable range, which also demonstrates the reliability of techniques used in this work. Compared with the literature,[29] a more extensive temperature range was investigated in this paper. Propylene carbonate is a typical physical solvent and is widely used as a decarbonization agent for the synthesis of ammonia process. To verify the efficiency and advantage of DMC, new solubility data of CO_2 in propylene carbonate at higher pressure are added, which also accord well with the existing experiment data,[30] as Table 4 and Figure 4 show.

In physical absorption, the solvent capacity depends on the gas partial pressure, which means that the physical absorption follows Henry's law. According to Henry's law, Henry's law constant can be considered as the slope of the line P to x. As shown in Figure 3 and Figure 4, the gas solubility in solvent follows Henry's law well at low pressure, and the deviation of linearity between P and x becomes larger as the pressure increases. As Table 5 shows, the value of Henry's law constant increases with temperature increase, which confirms the decrease in solubility of CO_2 in DMC with temperature increase for the pressure range studied.

This paper pays attention to the physical absorption in CO_2 capture. The existing decarbonization agents in industrial process have their own advantages, such as methanol, propylene carbonate, and polyethylene glycol dimethyl ether. However, to gain the best ratio of efficiency to cost and the greatest economic benefits in separation process, absorption is conducted at room temperature and high pressure. None of them can get this target, except DMC. Figure 5 shows that under the same temperature the absorption effect of DMC is better than propylene carbonate and methanol,[20,21] and the solubility of CO_2 in DMC at room temperature (298.47 K) is close to methanol at 263.15 K. This indicates that DMC as a physical solvent not only can be used at ambient temperature with low vaporization losses but also gets a better absorption effect.

Conclusions

The main conclusions of the study can be summarized as follows:

1. The constant-volume method is used to determine the solubility of CO_2 in DMC, and the reliability of the experimental apparatus is verified by the measurements of CO_2 solubility in water.

2. Under the pressure of 6 MPa and the temperature variations from (280.7 to 327.66) K, the solubility of CO_2 in both DMC and propylene carbonate decreases as temperature increases and pressure decreases.

3. It is found by contrast that DMC has a greater ability to dissolve CO_2 than propylene carbonate and methanol at the same temperature. Furthermore, the solubility of CO_2 in DMC at room temperature 298.47 K is close to that in methanol at 263.15 K. This indicates that DMC has the potential as a low-cost, green physical solvent for precombustion CO_2 capture.

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