

# Supporting Material

## Development of SO<sub>2</sub> Phase-change Absorption: Viscosity Change and Component Distribution Rules

*Shengchao Xu, Wenbo Zhao\*, Muyuan Chai, Tian Si, Yuan Chen, Qingming Jia\**

Faculty of Chemical Engineering, Kunming University of Science and Technology, Kunming, 650500,

China

E-mail: [wenshuixing@126.com](mailto:wenshuixing@126.com) and [jiaqm411@163.com](mailto:jiaqm411@163.com)

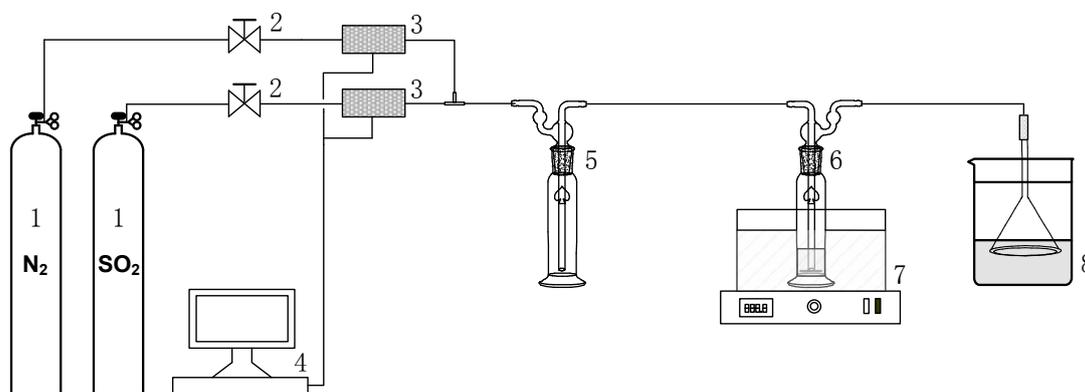


Fig. 1S SO<sub>2</sub> absorption equipment (1: gas cylinder; 2: valve; 3: mass flow meter; 4: computer; 5: gas mixing plant; 6: gas-washing bottle; 7: constant temperature water bath; 8: tail gas absorption plant)

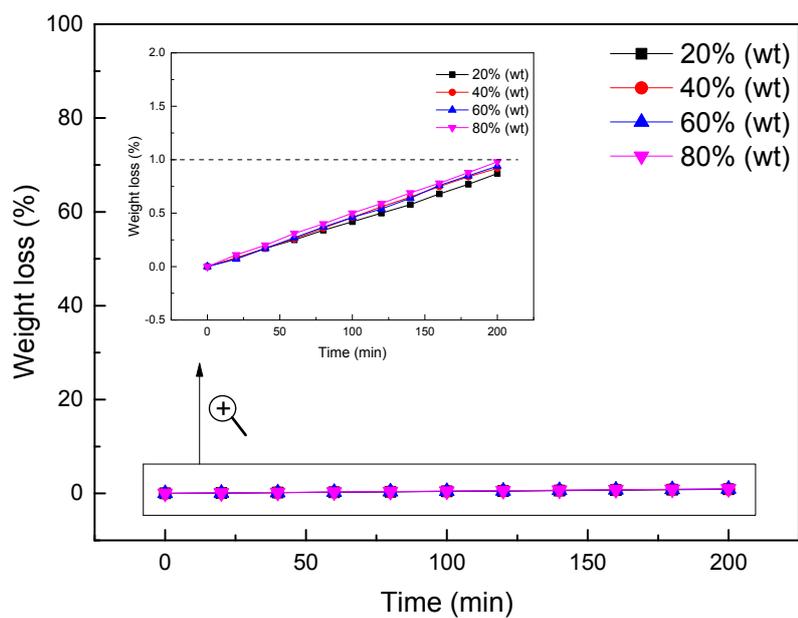


Fig. 2S Weight loss of the four solutions with different DMEA concentration at the same absorption

conditions

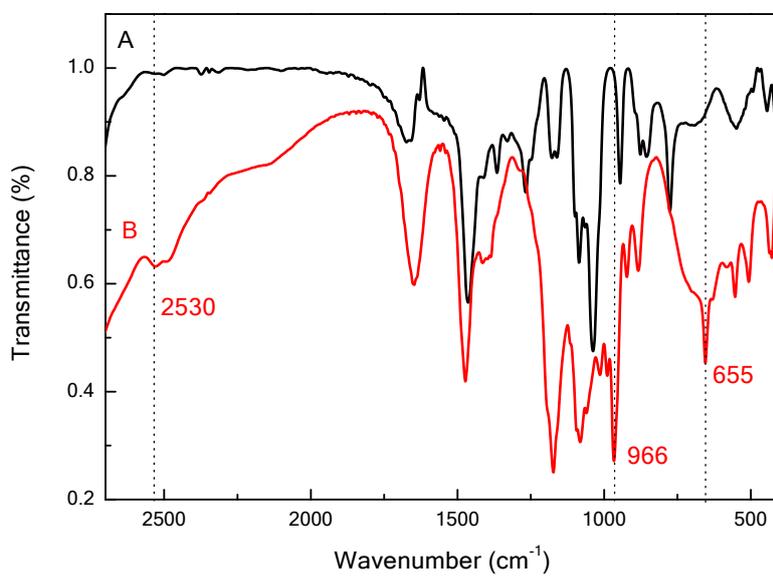


Fig. 3S Comparison of the FTIR spectrum of DMEA (A) and DMEA-SO<sub>2</sub> (B).

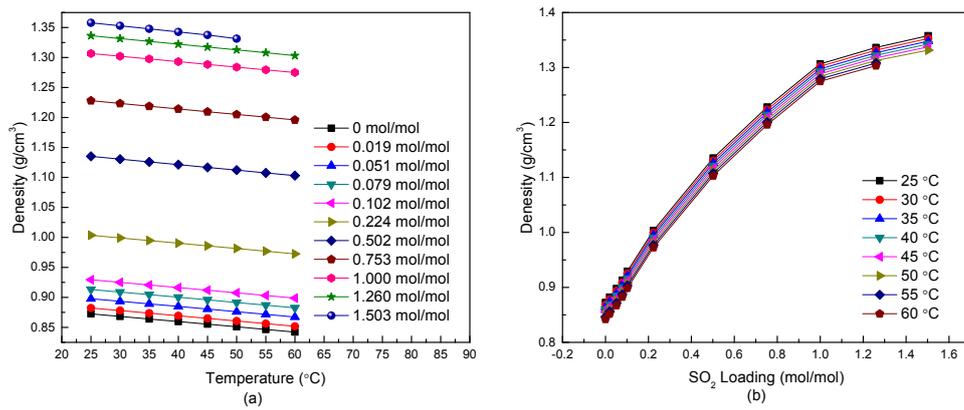


Fig. 4S Density of lower phase with the parameter temperature(a) and SO<sub>2</sub> loading(b)

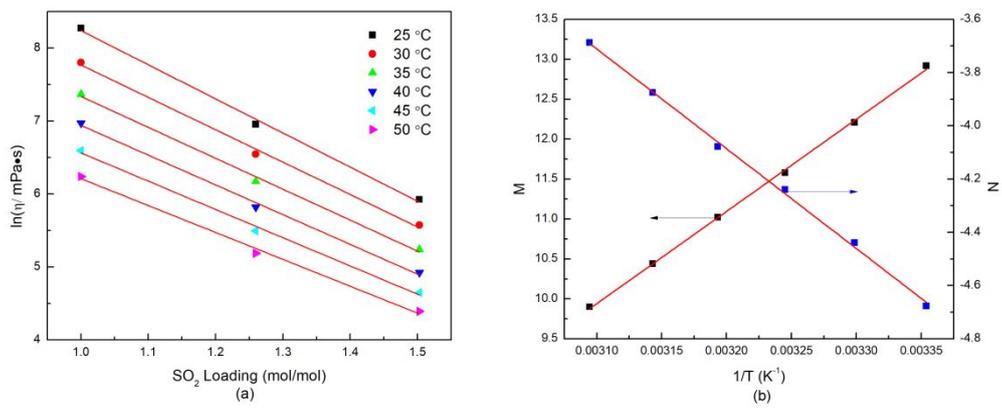


Fig. 5S Fitting results of viscosity(a) and M,N values(b)

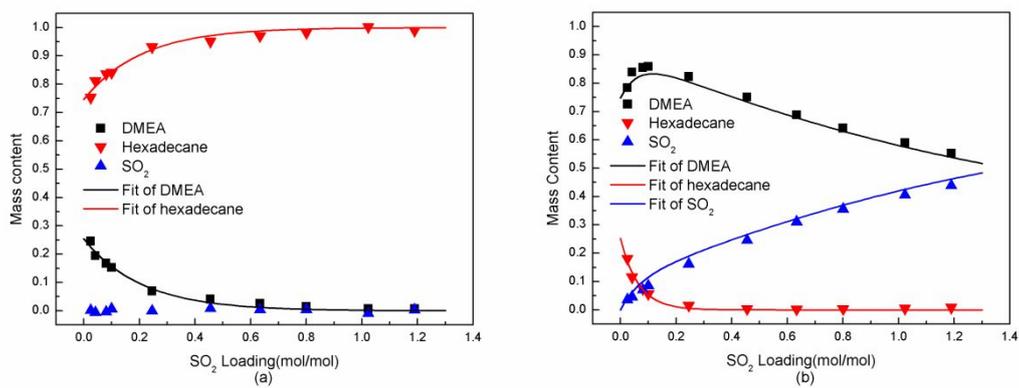


Fig. 6S (a) upper phase and (b) lower phase distributions with the SO<sub>2</sub> Loading

(40%DMEA+60%hexadecane) at 40 °C

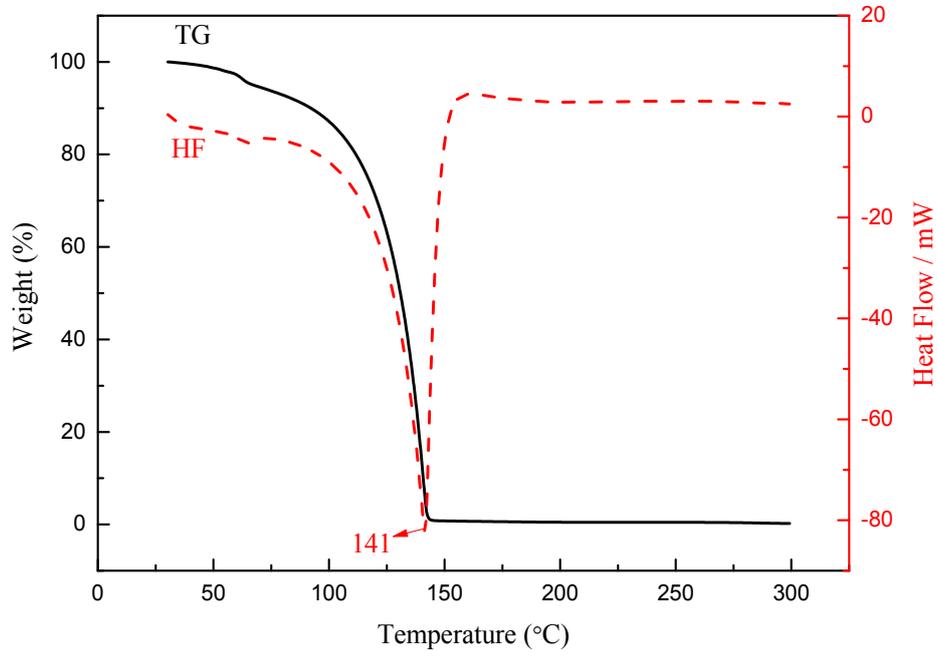


Fig. 7S TG-DSC curves of DMEA-SO<sub>2</sub>

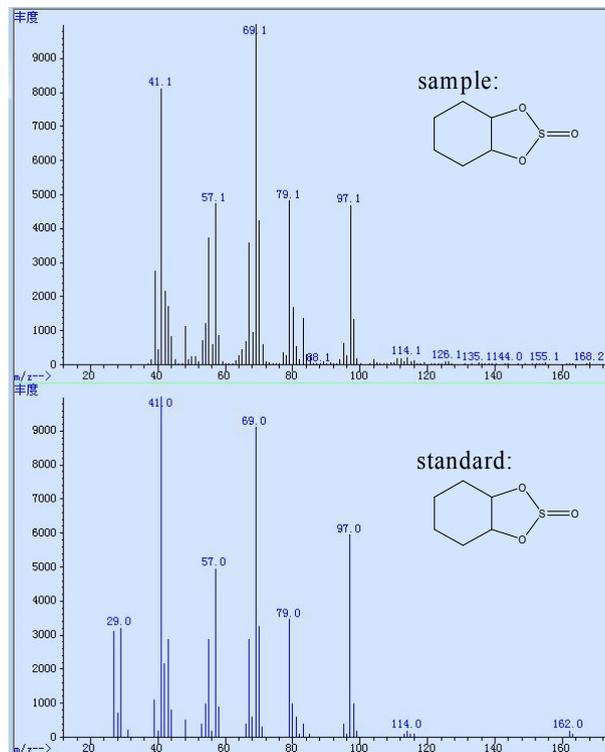


Fig. 8S GC-MS of Cyclohexane sulfite



Table 1S Density of the lower phase at different temperature and SO<sub>2</sub> loading

Temperature(°C)	Density (g/cm <sup>3</sup> )											
	0	0.019	0.051	0.078	0.102	0.224	0.502	0.753	1.000	1.260	1.503	
	mol/mol	mol/mol	mol/mol	mol/mol	mol/mol	mol/mol	mol/mol	mol/mol	mol/mol	mol/mol	mol/mol	mol/mol
25.00	0.872472	0.882232	0.897769	0.913134	0.929337	1.003564	1.135246	1.228019	1.306582	1.336361	1.357866	
30.00	0.868233	0.877980	0.893501	0.908862	0.925056	0.999180	1.130599	1.223351	1.302099	1.331612	1.352873	
35.00	0.863960	0.873700	0.889206	0.904560	0.920739	0.994790	1.125975	1.218752	1.297603	1.326912	1.347848	
40.00	0.859650	0.869378	0.884875	0.900227	0.916404	0.990387	1.121366	1.214193	1.293096	1.322220	1.342772	
45.00	0.855308	0.865024	0.880513	0.895861	0.912037	0.985971	1.116777	1.209648	1.288502	1.317513	1.337591	
50.00	0.850932	0.860633	0.876112	0.891464	0.907635	0.981523	1.112203	1.205096	1.283965	1.312781	1.331427	
55.00	0.846511	0.856206	0.871672	0.887025	0.903194	0.977061	1.107636	1.200542	1.279439	1.308027	-	
60.00	0.842059	0.851730	0.867191	0.882546	0.898718	0.972562	1.103073	1.195992	1.274887	1.303254	-	

Table 2S. Viscosities of the lower phase at different SO<sub>2</sub> loading and temperature

SO <sub>2</sub> loading (mol/mol)	Viscosity (mPa.s)							
	25.00 °C	30.00 °C	35.00 °C	40.00 °C	45.00 °C	50.00 °C	55.00 °C	60.00 °C
0	3.0225	2.6611	2.3034	2.0450	1.8157	1.6224	1.4799	1.3184
0.019	3.4568	2.9972	2.6166	2.3011	2.1093	1.8750	1.6177	1.4535
0.051	4.4584	3.7340	3.2349	2.8228	2.4796	2.1905	1.9467	1.7371
0.078	5.3979	4.6037	3.9583	3.4327	3.0016	2.7920	2.3207	2.0620
0.102	6.5472	5.5420	4.7303	4.0737	3.6457	3.1378	2.8650	2.3994
0.224	18.510	14.886	12.177	10.083	8.6229	7.1381	6.0938	5.2367
0.502	169.66	120.51	87.686	64.878	47.514	35.596	28.136	23.068
0.753	1070.3	691.05	473.16	327.94	231.55	170.41	127.55	97.247
1.000	3922.1	2446.8	1585.3	1066.0	731.22	513.94	368.97	270.11
M	1.1633	1.0236	0.89004	0.76635	0.66148	0.55127	0.43560	0.32176
N	7.4163	7.0554	6.7391	6.4401	6.1360	5.8716	5.6492	5.4511
R <sup>2</sup>	0.99548	0.99583	0.99598	0.99639	0.99689	0.99729	0.99715	0.99707

Table 3S Viscosities of the lower phase at different SO<sub>2</sub> loading and temperature

SO <sub>2</sub> loading (mol/mol)	Viscosity (mPa.s)					
	25 °C	30 °C	35 °C	40 °C	45 °C	50 °C
1.000	3922.1	2446.8	1585.3	1066.0	731.22	513.94
1.260	1047.8	697.28	479.91	336.59	243.27	179.20
1.503	374.44	263.21	188.48	137.45	104.44	80.668
M	12.918	12.209	11.578	11.020	10.440	9.8989
N	-4.6773	-4.4397	-4.2403	-4.0789	-3.8754	-3.6878
R <sup>2</sup>	0.99446	0.99418	0.99465	0.99425	0.99356	0.99263

Table 4S Distributions of MDEA, hexadecane and SO<sub>2</sub> in the upper and lower phase  
(40% DMEA + 60% hexadecane, 20 °C)

SO <sub>2</sub> loading (mol/mol)	Upper phase(wt)			Lower phase(wt)		
	DMEA	Hexadecane	SO <sub>2</sub>	DMEA	Hexadecane	SO <sub>2</sub>
0.021	0.198	0.799	0.003	0.813	0.161	0.026
0.031	0.170	0.830	0.000	0.836	0.130	0.034
0.040	0.155	0.842	0.003	0.854	0.108	0.038
0.064	0.125	0.875	0.000	0.867	0.083	0.050
0.091	0.113	0.886	0.001	0.874	0.054	0.072
0.111	0.099	0.900	0.001	0.873	0.041	0.086
0.201	0.061	0.943	-0.004	0.849	0.016	0.135
0.302	0.047	0.955	-0.002	0.809	0.006	0.185
0.408	0.029	0.974	-0.003	0.768	0.003	0.229
0.501	0.028	1.007	-0.035	0.736	0.003	0.260
0.603	0.020	1.021	-0.042	0.705	0.001	0.295
0.708	0.016	1.022	-0.038	0.673	0.002	0.325
0.819	0.012	1.025	-0.037	0.640	0.002	0.359
0.902	0.010	1.026	-0.036	0.620	0.002	0.378
1.008	0.010	1.026	-0.035	0.595	0.003	0.402
1.113	0.010	1.023	-0.032	0.565	0.004	0.431
1.307	0.010	1.024	-0.034	0.549	0.002	0.448
1.507	0.010	1.017	-0.026	0.513	0.001	0.487

Table 5S Distributions of MDEA, hexadecane and SO<sub>2</sub> in the upper and lower phase  
(40% DMEA + 60% hexadecane, 40 °C)

SO <sub>2</sub> loading (mol/mol)	Upper phase(wt)			Lower phase(wt)		
	DMEA	Hexadecane	SO <sub>2</sub>	DMEA	Hexadecane	SO <sub>2</sub>
0.025	0.246	0.753	0.002	0.784	0.180	0.036
0.042	0.194	0.812	-0.006	0.839	0.115	0.046
0.081	0.167	0.836	-0.004	0.855	0.074	0.071
0.100	0.152	0.841	0.007	0.859	0.056	0.085
0.246	0.069	0.931	0.000	0.823	0.015	0.162
0.455	0.041	0.951	0.008	0.751	0.003	0.246
0.634	0.026	0.971	0.004	0.688	0.002	0.310
0.801	0.014	0.982	0.004	0.641	0.003	0.356
1.023	0.007	1.002	-0.009	0.590	0.005	0.406
1.190	0.007	0.989	0.004	0.553	0.008	0.439