



*Supplement of*

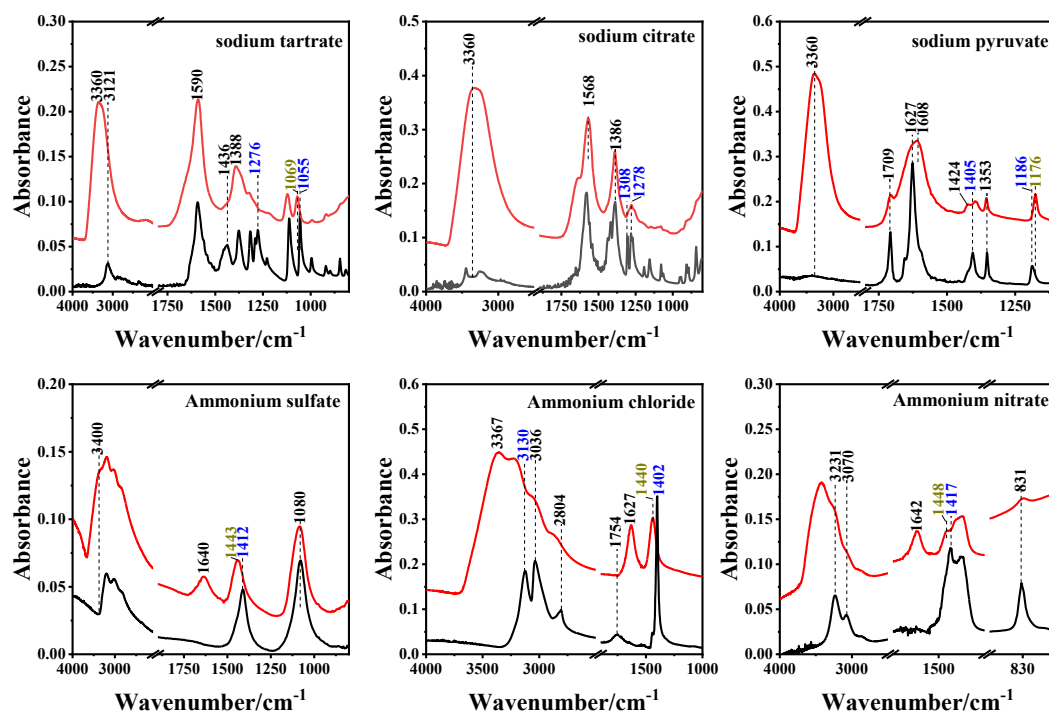
## **The interplay between aqueous replacement reaction and the phase state of internally mixed organic/ammonium aerosols**

**Hui Yang et al.**

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This file contains, Supplementary Tables: 1 and Supplementary Figures: 1-5

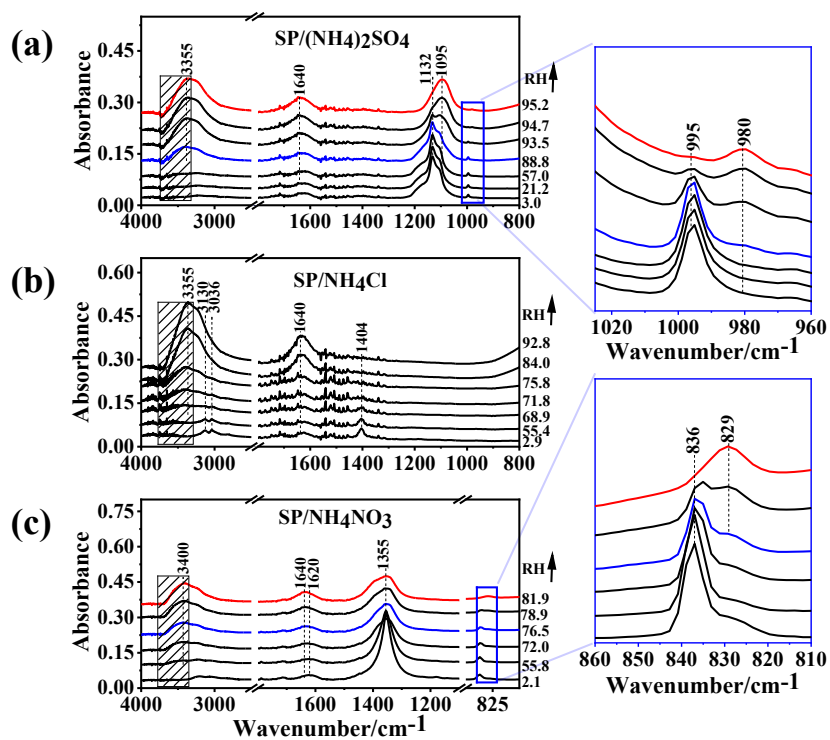


**Fig. S1.** The IR spectra at aqueous (red line) and solid (black) state, as well as the solid features (black value) and solution bands for organic salts and ammonium salts.

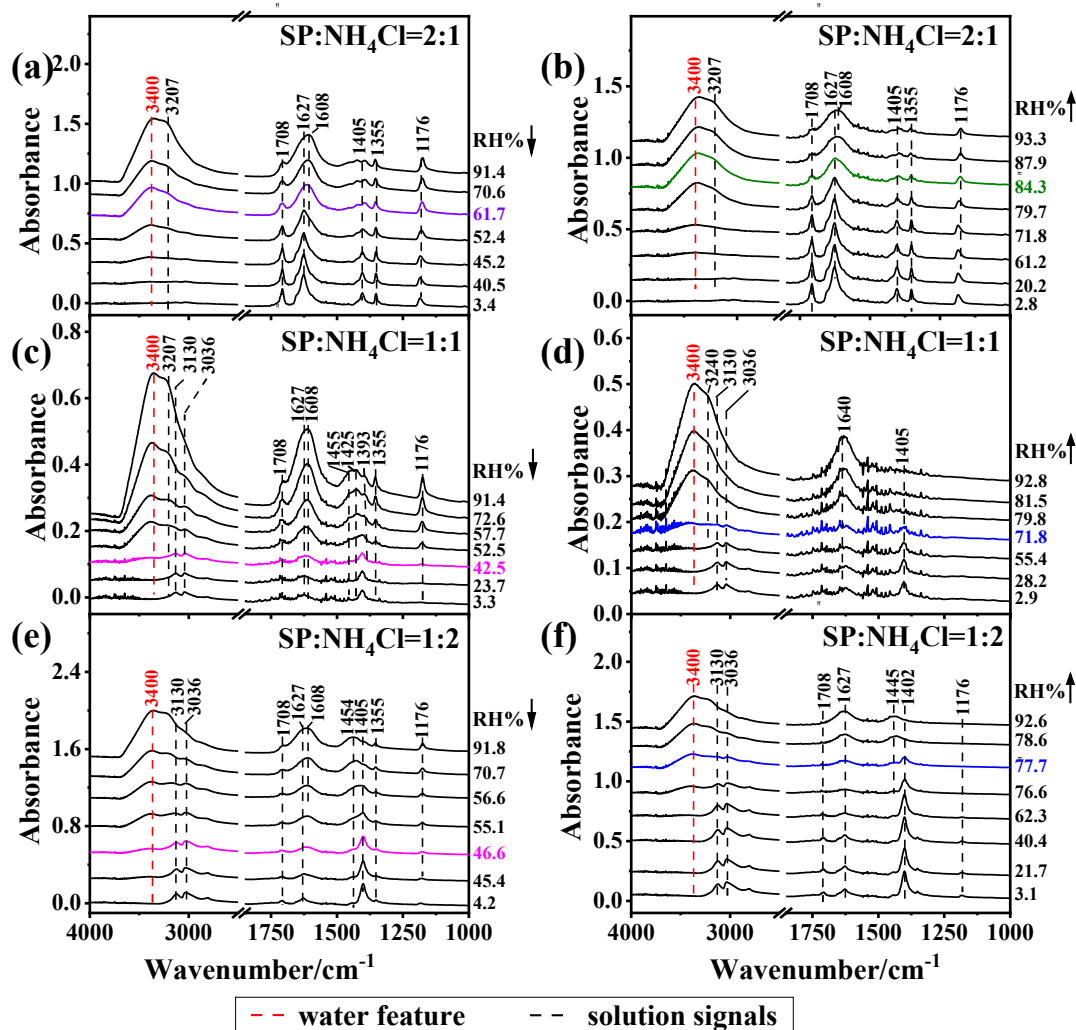
**Table S1** Assignments of IR Peaks Attributed to Ammonium and Carboxylates

IR bands (cm <sup>-1</sup> )						assignment
SP	SC	ST	NH <sub>4</sub> NO <sub>3</sub>	NH <sub>4</sub> Cl	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	
			831			v <sub>2</sub> -NO <sub>3</sub> <sup>-</sup>
		1055(s)				γ(CH <sub>2</sub> )
		1069(l)				γ(CH <sub>2</sub> )
1176(l)						v (C-C) + γ (COO <sup>-</sup> )(liquid)
					1180	v <sub>3</sub> (SO <sub>4</sub> <sup>2-</sup> )
1186(s)						v (C-C) + γ (COO <sup>-</sup> )
	1278	1276(s)				v(C-C)
	1308					ω(CH <sub>2</sub> )
1353						δ <sub>s</sub> (CH <sub>3</sub> )
	1386	1388(l)				v <sub>s</sub> (COO <sup>-</sup> )
1404(s)			1417(s)	402(s)	1412(s)	v <sub>2</sub> (NH <sub>4</sub> <sup>+</sup> )(solid)
						v <sub>s</sub> (COO <sup>-</sup> )
1424(l)		1436(s)	1448(l)	1440(l)	1443(l)	v <sub>2</sub> (NH <sub>4</sub> <sup>+</sup> )(liquid)
	1568					v <sub>as</sub> (COO <sup>-</sup> )
1608(l)						δ (OH) + v (CO)
1627(s)						v <sub>s</sub> (COO <sup>-</sup> )
1654(s)						v <sub>s</sub> (COO <sup>-</sup> )
1709						v <sub>as</sub> (COO <sup>-</sup> )
						v <sub>as</sub> (C=O)
				1754		
				2804		v (NH <sub>4</sub> <sup>+</sup> )
				3036		v (NH <sub>4</sub> <sup>+</sup> )
				3130		v (NH <sub>4</sub> <sup>+</sup> )
3360						v <sub>as</sub> (O-H)

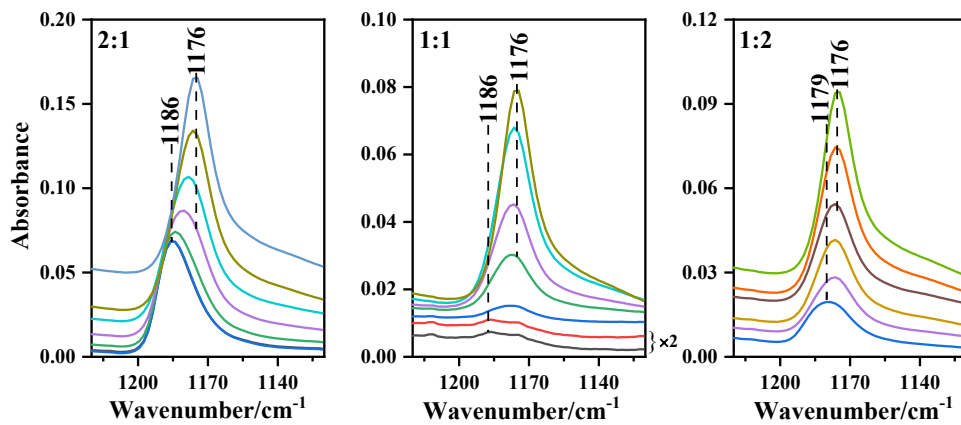
s: solid state    l: liquid state



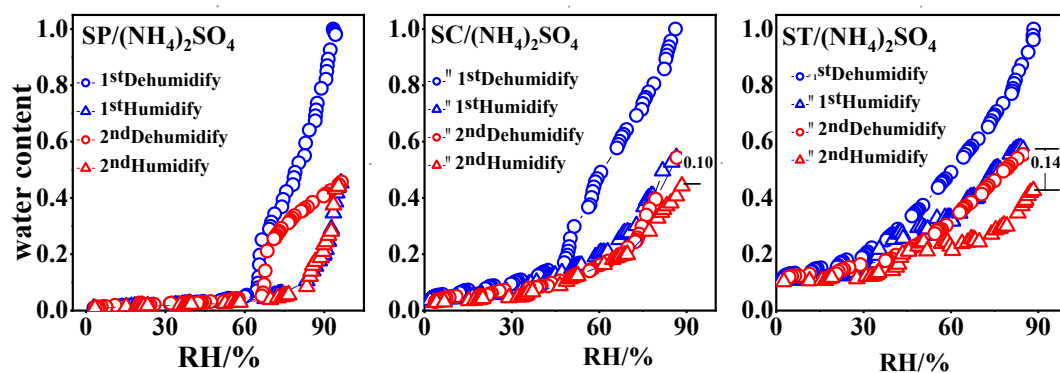
**Fig. S2.** The FTIR spectra of mixed aerosols containing pyruvate sodium and different ammonium salts which are (a) (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> (b) NH<sub>4</sub>Cl and (c) NH<sub>4</sub>NO<sub>3</sub> on hydration. The shaded area shows the chosen integration region for liquid water. The blue and red lines of (a) indicate onset and end of Na<sub>2</sub>SO<sub>4</sub> deliquescence; the blue and red lines of (c) are onset and end of NaNO<sub>3</sub> deliquescence.



**Fig. S3.** The IR spectra of SP/NH<sub>4</sub>Cl particles with various molar ratios during dehumidification ((a), (c), (e)) and humidification ((b), (d) and (f)), respectively. The purple line of (a) indicates onset of SP efflorescence and the green line of (b) refers to the onset of NH<sub>4</sub>Cl deliquescence; The pink lines in (c) and (e) mean onsets of NH<sub>4</sub>Cl efflorescence and the blue lines in (d) and (f) refers to onsets of NH<sub>4</sub>Cl deliquescence.



**Fig. S4.** The IR spectral comparison in the region of 1220–1120 cm<sup>-1</sup> for 2:1, 1:1 and 1:2 SP/NH<sub>4</sub>Cl particles during the dehumidification



**Fig. S5.** Hygroscopicity curve comparison of particles containing SP : AS (ammonium sulfate) = 2:1 (left), SC: AS = 2:3 (center) and, ST: AS = 1:1 (right) during two down-up RH cycles. The data for SP:AS = 2:1 was reported previously by Yang et al (2019).

## Reference

Yang, H., Wang, N., Pang, S., Zheng, C., Zhang, Y.: Chemical reaction between sodium pyruvate and ammonium sulfate in aerosol particles and resultant sodium sulfate efflorescence, *Chemosphere*, 215, 554–562, <https://doi.org/10.1016/j.chemosphere.2018.10.062>, 2019.