

Measurement of activity coefficients at infinite dilution in $[N_{2212OCH_3}][NTf_2]$ for organic solute and water using GLC method



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Abstract

Activity coefficients at infinite dilution for new ionic liquid: N,N-Diethyl-N-methyl-N-(2-methoxyethyl)ammonium bis(trifluoromethylsulfonyl)imide, $[N_{2212OCH_3}][NTf_2]$ for organic solute (alkanes, alkenes, alkynes, cycloalkanes, aromatic hydrocarbons, alcohols, ethers, ketones, thiophene) and water have been measured using gas-liquid chromatography. The measurements were carried out at temperatures ranging from 318.15 to 358.15K. The activity coefficients were used to calculate excess enthalpy, excess entropy and excess Gibbs energy at infinite dilution and selectivities for the aliphatic from aromatic hydrocarbons and *n*-heptane/thiophene separation problems and compared to the other ionic liquids found in recent literature. The basic thermal properties of pure IL have been measured using a differential scanning microcalorimetry technique (DSC). Additionally, density, viscosity and surface tension of pure IL have been measured.

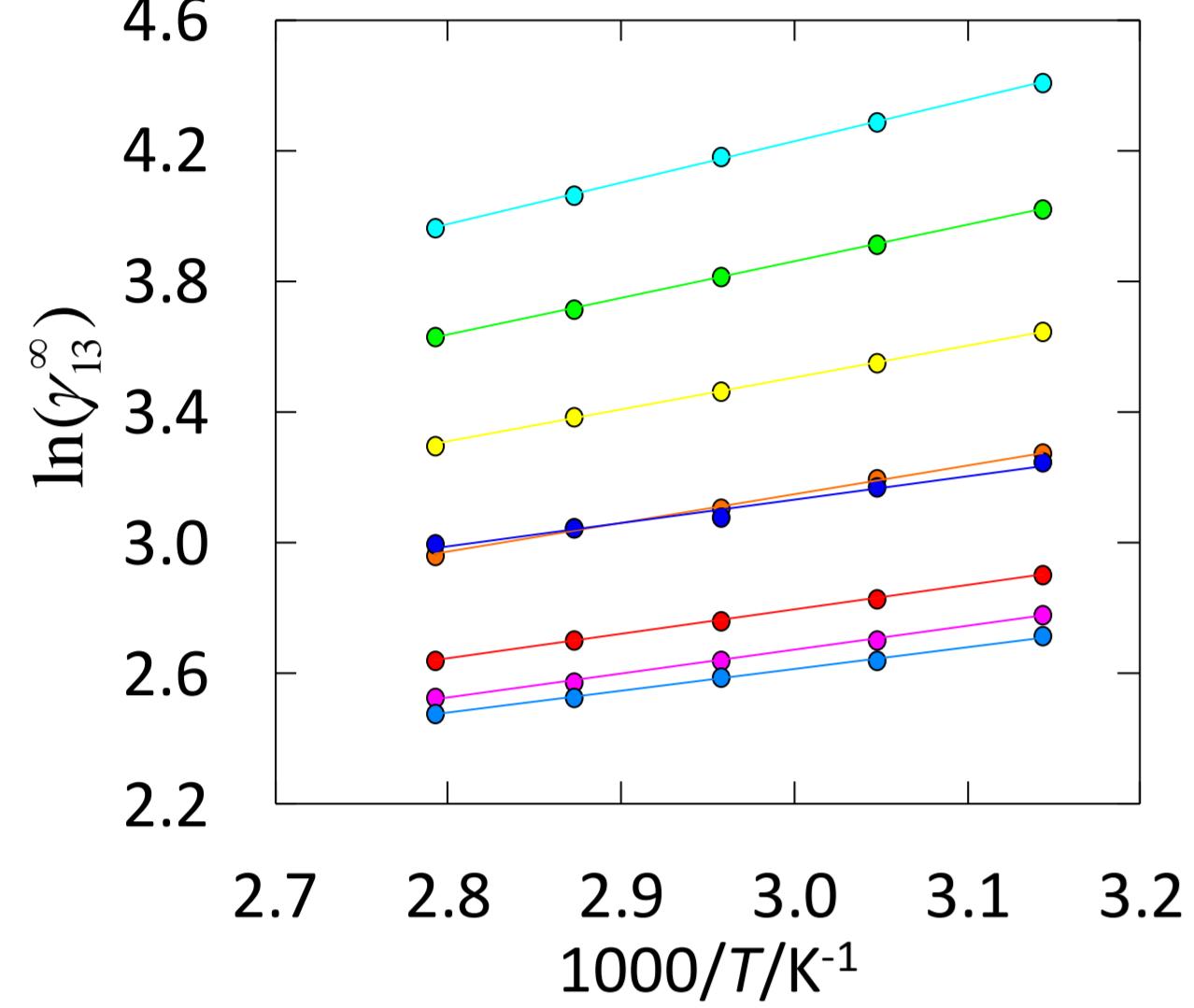


Fig. 1 Activity coefficients γ_{13}^{∞} as a function of reversed temperature for the following solutes: (●) hexane, (●) 3-methylpentane, (●) 2,2-dimethylbutane, (●) heptane, (●) octane, (●) 2,2,4-trimethylpentane, (●) nonane, (●) decane.

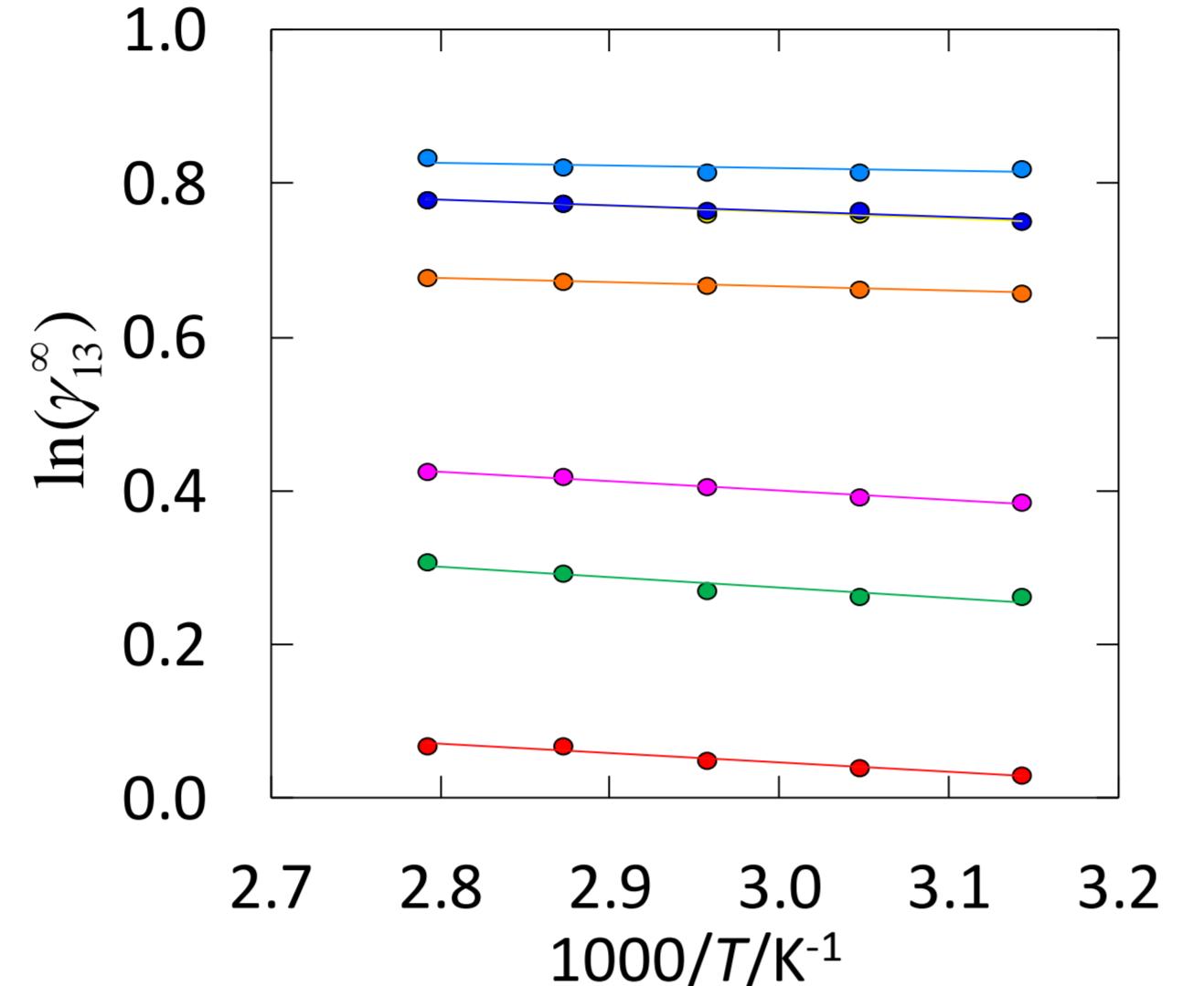


Fig. 2 Activity coefficients γ_{13}^{∞} as a function of reversed temperature for the following solutes: (●) benzene, (●) toluene, (●) ethylbenzene, (●) *o*-xylene, (●) *m*-xylene, (●) *p*-xylene, (●) styrene.

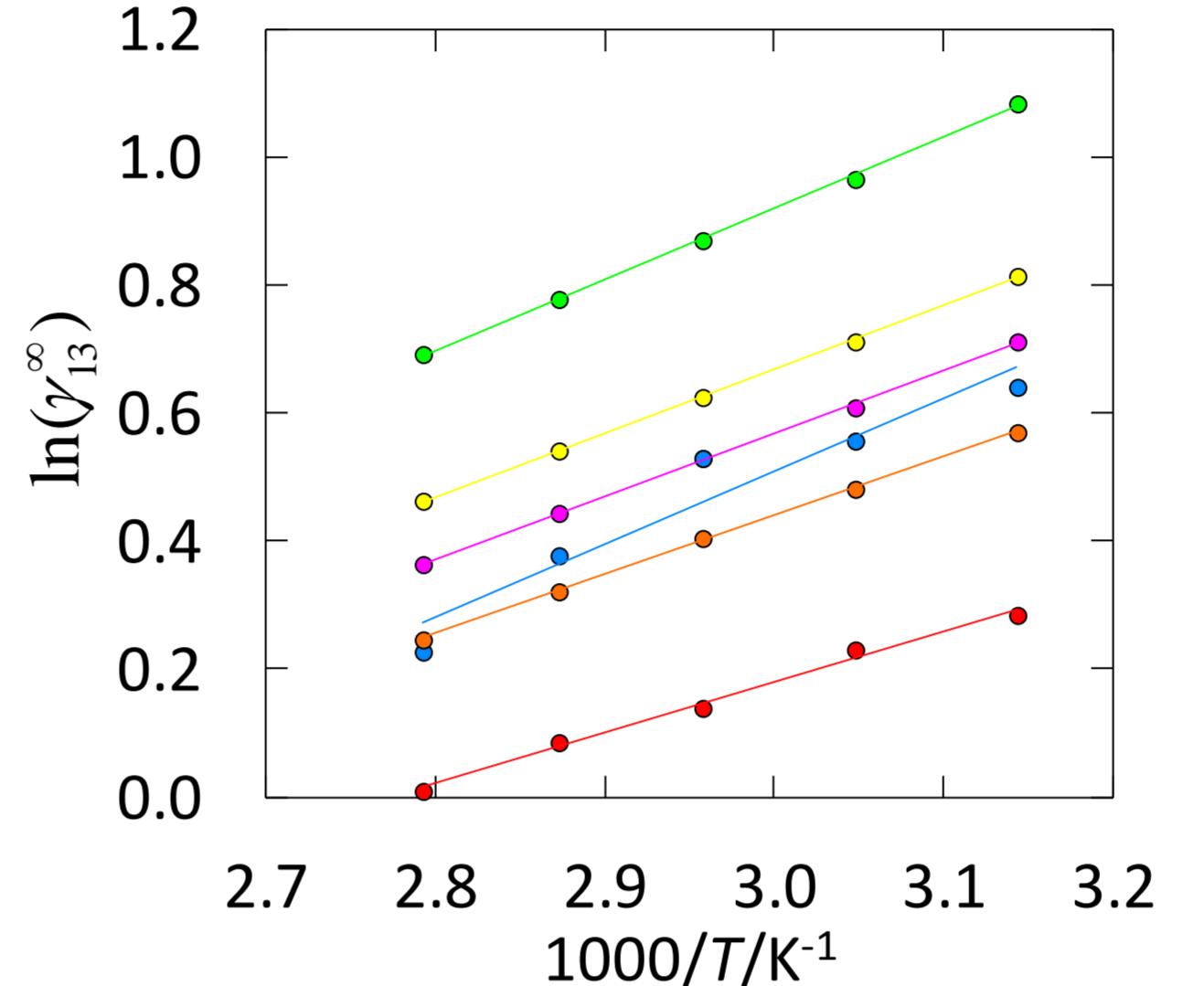


Fig. 3 Activity coefficients γ_{13}^{∞} as a function of reversed temperature for the following solutes: (●) methanol, (●) ethanol, (●) 1-propanol, (●) 2-propanol, (●) 1-butanol, (●) water.

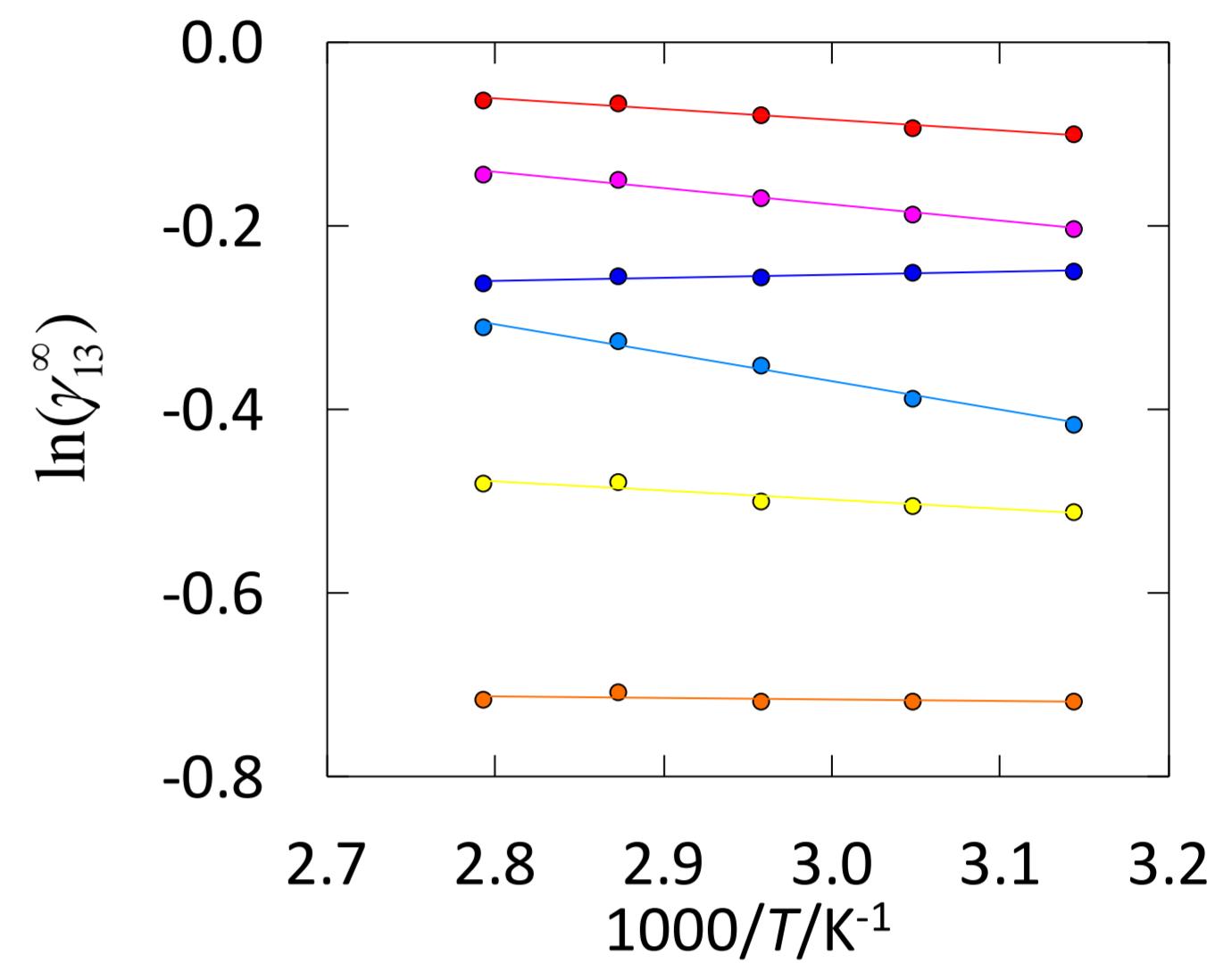


Fig. 4 Activity coefficients γ_{13}^{∞} as a function of reversed temperature for the following solutes: (●) thiophene, (●) tetrahydrofuran, (●) 1,4-dioxane, (●) acetonitrile, (●) pyridine, (●) nitropropane.



Pic. 1 Gas chromatograph with TCD detector Clarus 480, Perkin Elmer corp.

| Ionic liquid | $S_{1,2}^{\infty}$ | | k_2^{∞} | | | | |
|---------------------------|--------------------|----------------------|--------------------|-------------------|---------|-----------|----------|
| | Hexane/ benzene | Cyclohexane/ benzene | Heptane/ thiophene | Heptane/ pyridine | Benzene | Thiophene | Pyridine |
| $[N_{2212OCH_3}][NTf_2]$ | 16.3 | 5.35 | 26.8 | 40.4 | 0.96 | 1.10 | 1.66 |
| $[N_{1112OH}][NTf_2]$ [1] | 24.8 | 12.5 | 47.2 | 295 | 0.40 | 0.49 | 3.05 |
| $[COC_2mMOR][NTf_2]$ [2] | 24.7 | 12.9 | 45.1 | | 0.76 | 0.93 | |
| $[BMMOR][TCM]$ [3] | 33.0 | 13.4 | 73.8 | 103 | 0.65 | 0.96 | 1.34 |
| $[N_{1116}][NTf_2]$ [4] | 9.90 | | 10.7 | | | | |
| $[N_{1111O}][NTf_2]$ [5] | 5.93 | 4.18 | 7.76 | 10.9 | 1.42 | 1.49 | 2.13 |
| $[N_{1118}][NTf_2]$ [5] | 8.21 | 5.55 | 11.6 | 17.8 | 1.37 | 1.45 | 2.27 |
| $[N_{4441}][NTf_2]$ [5] | 7.50 | 5.22 | 10.3 | 15.8 | 1.10 | 1.16 | 1.78 |
| $[N_{8888}][NTf_2]$ [5] | 3.19 | 2.33 | 3.72 | 4.48 | 2.47 | 2.50 | 3.03 |
| $[N_{1888}][NTf_2]$ [6] | 3.50 | 2.50 | | | 3.17 | | |
| NMP [7] | 9.86 | 6.21 | | | 0.95 | | |
| Sulfolane [8] | 16.1 | 7.54 | | | 0.43 | | |



Pic. 2 Differential scanning calorimeter DSC 1, Mettler Toledo corp.

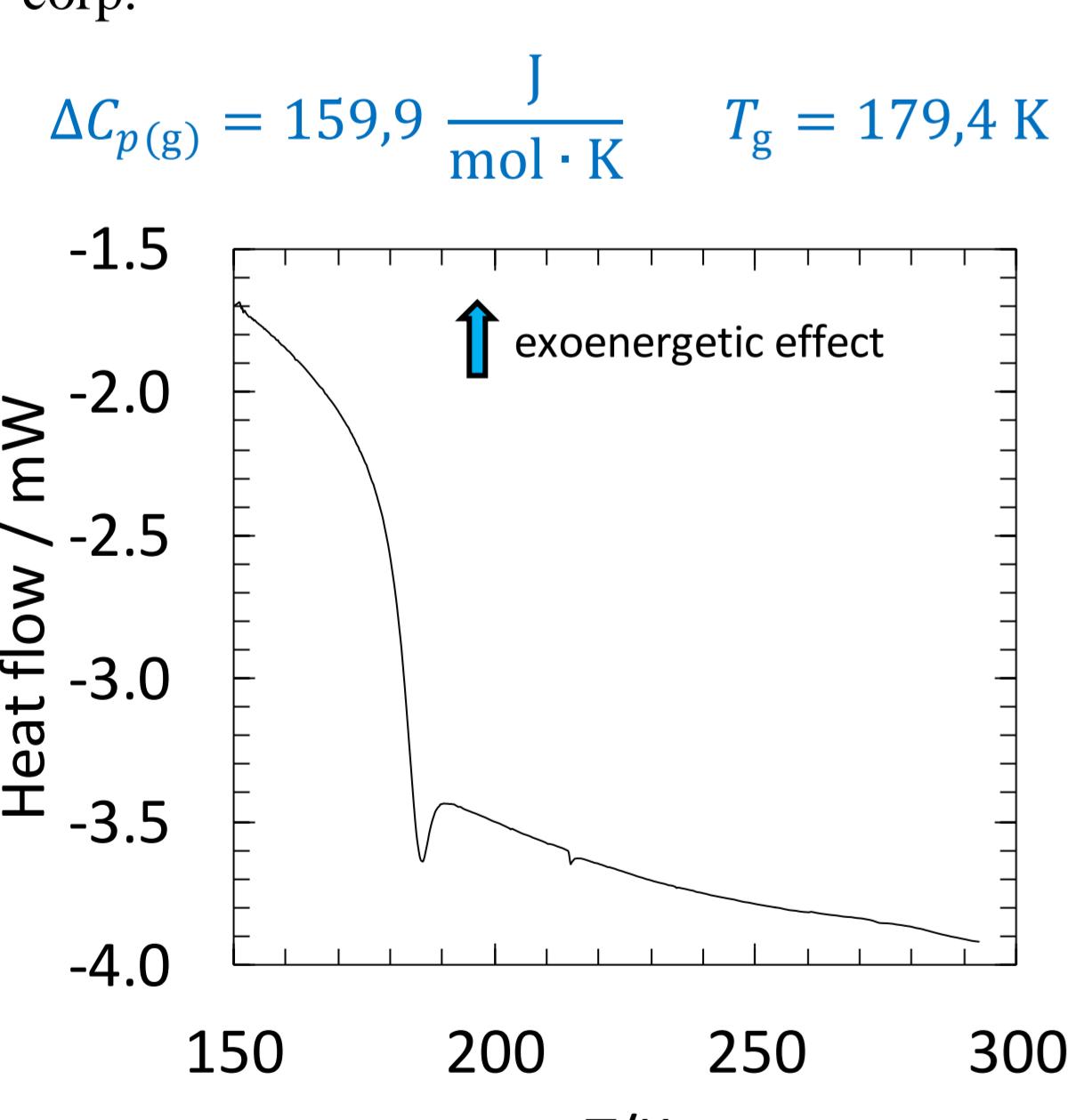


Fig. 5 Curve of differential scanning calorimetry (DSC) during the heating of ionic liquid $[N_{2212OCH_3}][NTf_2]$. Heating rate 10 K / min.

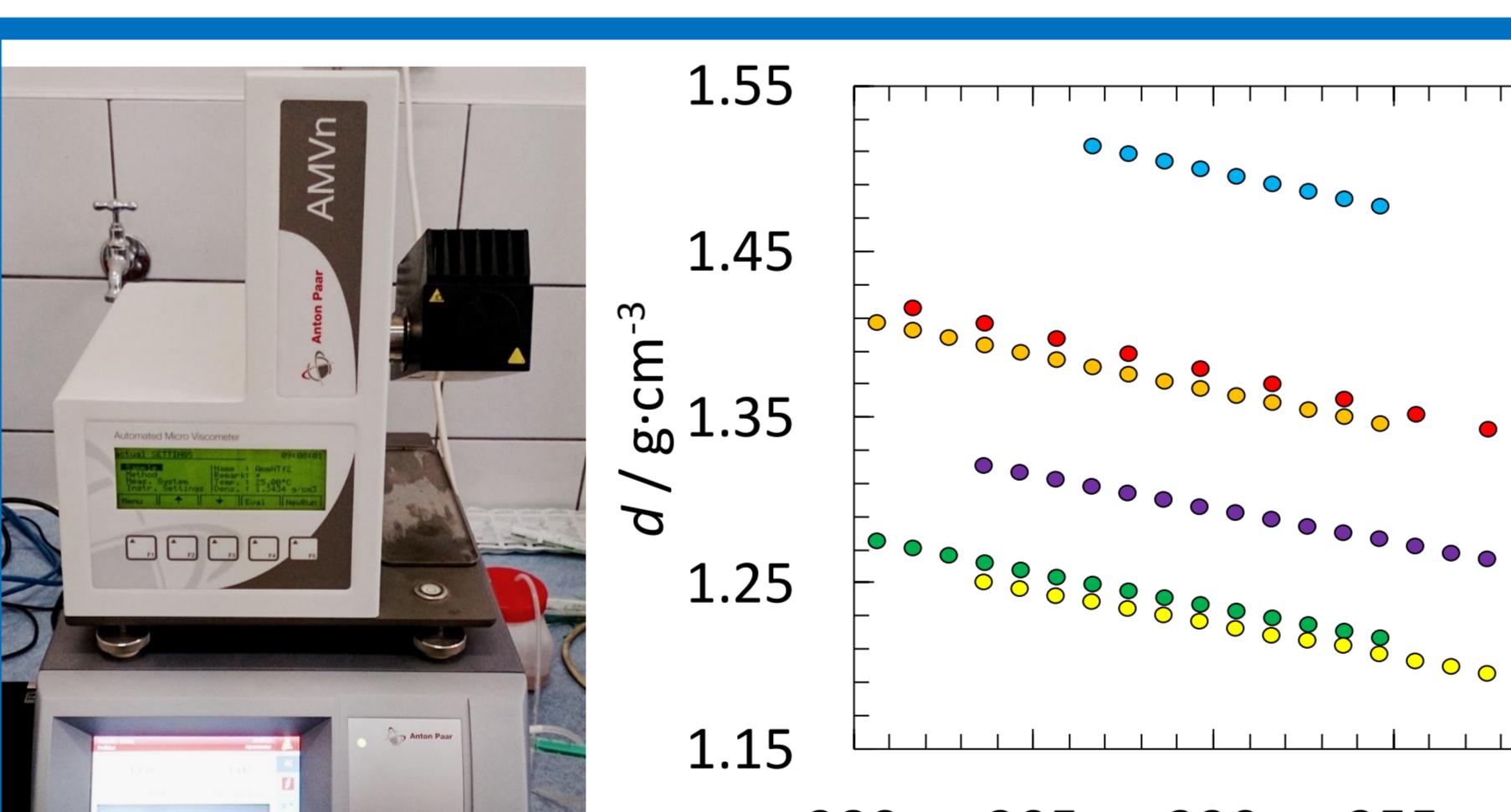


Fig. 6 Density of ionic liquids as a function of temperature

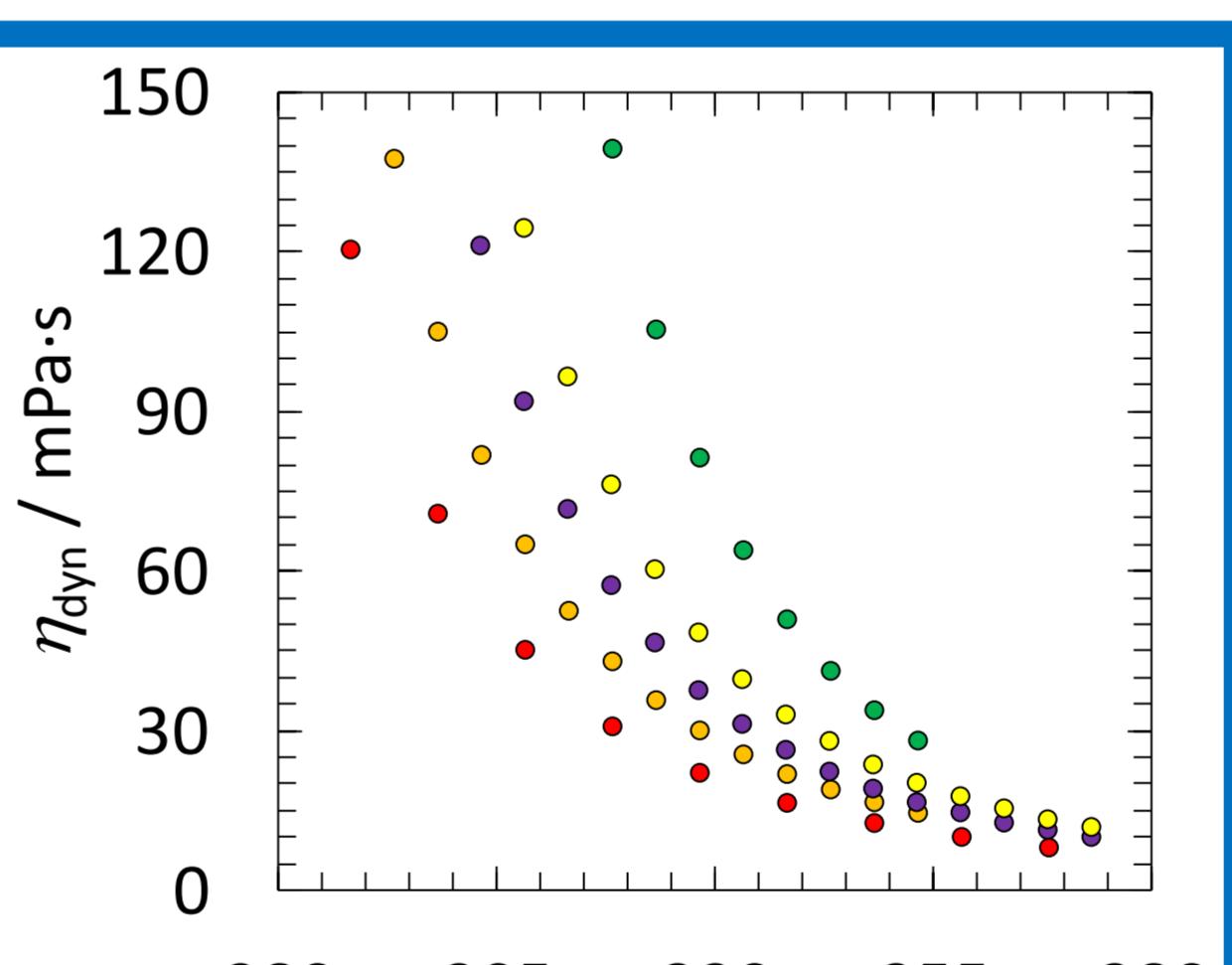


Fig. 7 Dynamic viscosity of ionic liquids as a function of temperature

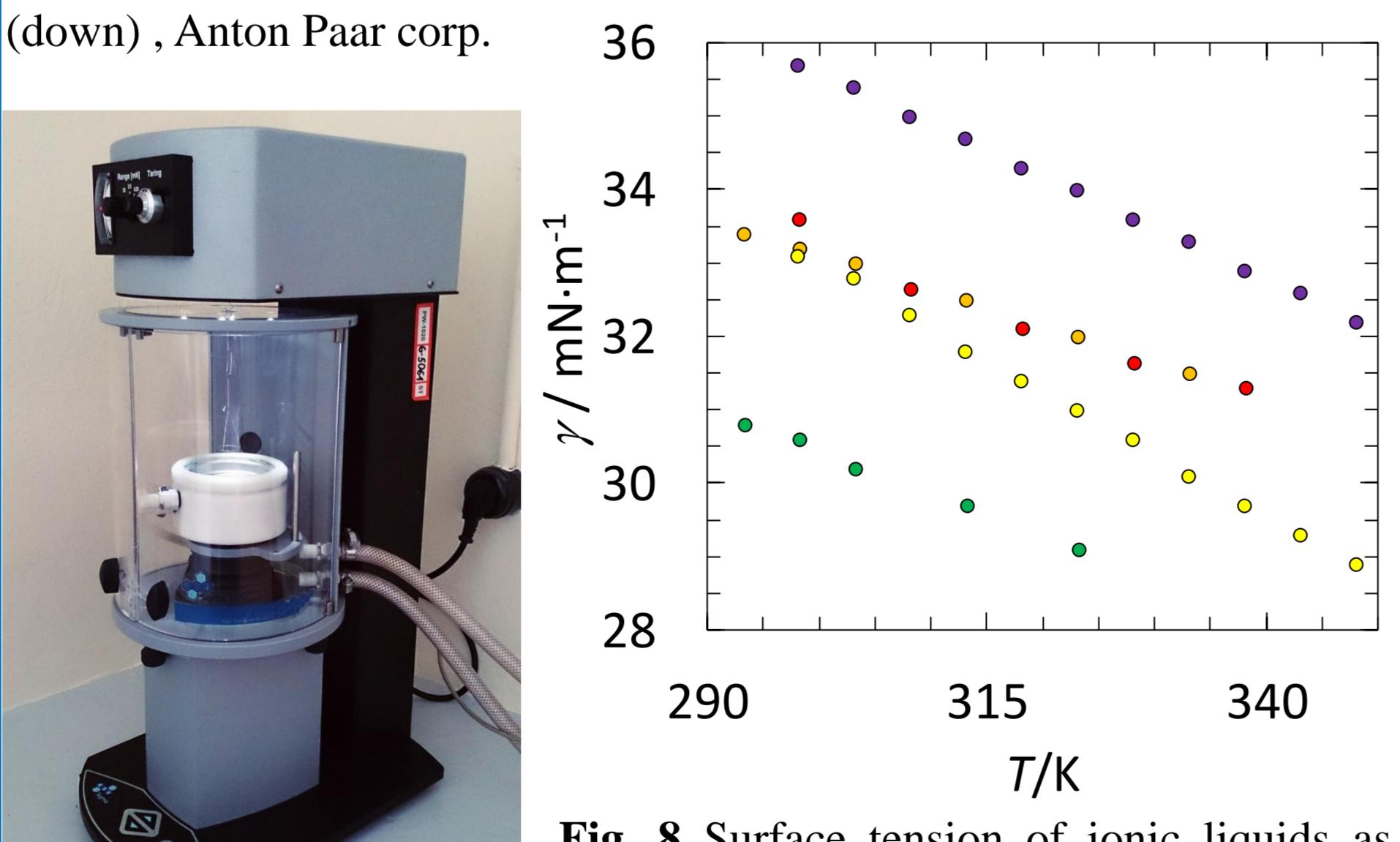


Fig. 8 Surface tension of ionic liquids as a function of temperature.

- $[N_{2212OCH_3}][NTf_2]$ own measurement
- $[N_{1112OH}][NTf_2]$ [1]
- $[N_{4441}][NTf_2]$ [5]
- $[N_{4111}][NTf_2]$ [9]
- $[N_{2225}][NTf_2]$ [10]
- $[N_{2228}][NTf_2]$ [11]

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