Low-Viscous Zwitterionic Liquids with a Flexible Spacer

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Zwitterions, a category of ionic liquids, have been considered for utilization in various fields as low-toxicity solvents while preserving the exceptional properties of ionic liquids. However, most zwitterions are solid at ambient temperature. Zwitterionic liquids that are liquid at room temperature have been reported.[1, 2] However, zwitterionic liquids exhibit extremely high viscosity, which limits their practical applications.[3] The high viscosity is presumably caused by the rigid spacers between the cation and anion, which hinder their independent mobility. We here propose a novel approach to address this limitation by using a flexible ether spacer (Fig. 1a).[4] The zwitterionic liquid with an ether spacer demonstrated a low viscosity of 810 mPa·s at 80 °C (Fig. 1b). This zwitterionic liquid exhibited the ability to dissolve 11 wt% of cellulose, which is known to be poorly soluble, in comparison to 1 wt% for the conventional zwitterionic liquid.

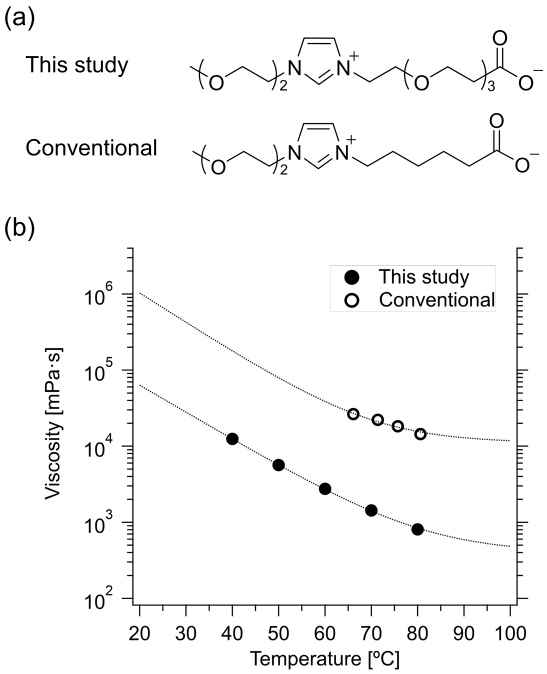

Fig 1. (a) Structures of zwitterionic liquids. (b) Temperature-dependent viscosity of zwitterionic liquids.

References

1. Mei, W. *et al., J. Chem. Phys.* **2021**, *155,* 244505.
2. Jadhav, S. *et al.*, *Cellulose* **2023**, *30,* 87–109.
3. Komori, T. *et al.*, *ACS Sustain. Chem. Eng.* **2021**, *9,* 11825–11836.
4. **Shimizu, M.** *et al., Chem. Commun.* **2025**, *61,* 4702–4705.

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