Broadband shear mechanical and dielectric investigation of monohydroxy alcohols close to the glass transition temperature.

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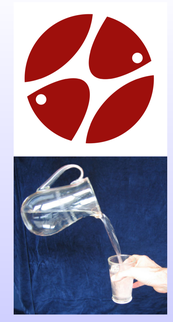


Background

Well-known that mono-alcohols have

- Strong Debye-like peak in the dielectric spectrum
- One or more additional non-Debye dielectric relaxation processes
- Separated mechanical and dielectric timescales

Recent results suggests that

- Debye-like peak does *not* represent the alpha relaxation
- *Secondary* dielectric relaxation is associated with alpha relaxation

Experimental

Shear-mechanical measurements

- Piezoelectric shear modulus gauge
- Frequency range 10^{-3}Hz – 10^{4}Hz

Dielectric measurements

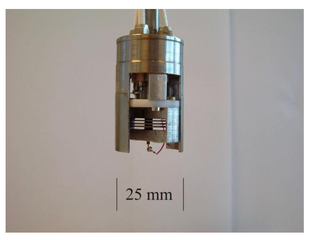
- Multilayered gold-plated capacitor

Common for both

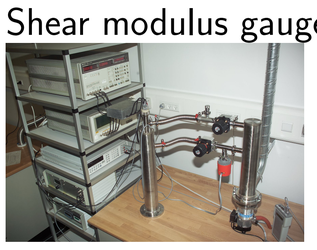
- Same cryostat for direct comparison
- Measurements in thermal equilibrium

Liquids

2-butanol and 2-ethyl-1-hexanol

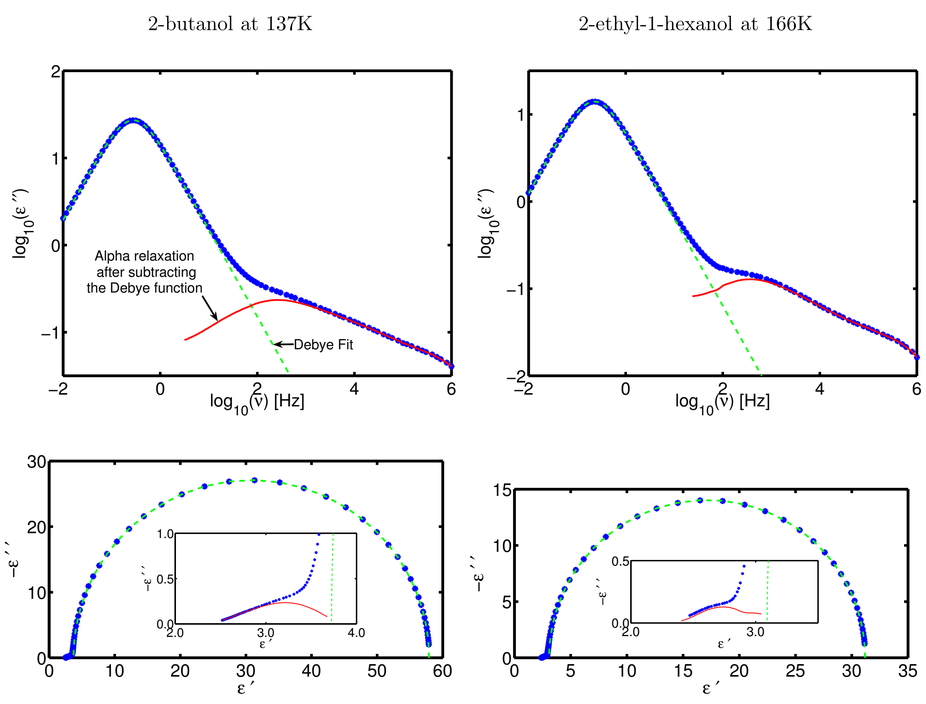


Shear modulus gauge



Experimental setup

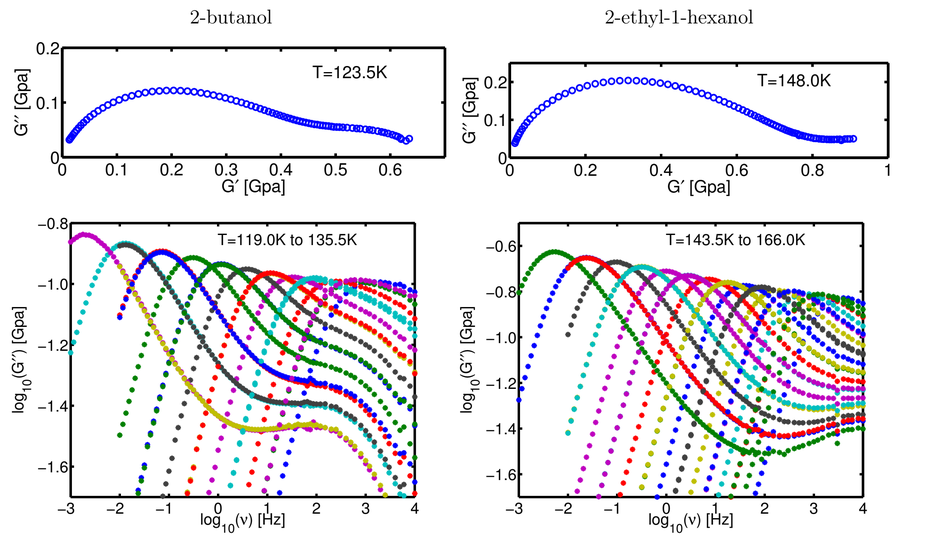
Dielectric data



Points are measured data, green dashed line is a fit of the main peak to a Debye-function and the red full line the residual after subtracting the Debye-function from the measured data.

- Clear Debye-like main relaxation
- Visible non-Debye second relaxation

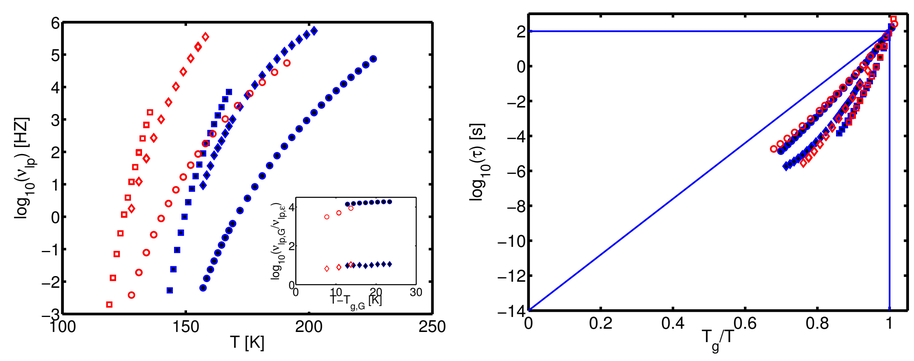
Shear data



Top: Nyquist plot at representative temperature.
Bottom: Shear mechanical loss as function of frequency.

- Clear non-Debye alpha, and Johari-Goldstein beta relaxation
- *If* shear signature of Debye-like process exists, its relaxation strength is below 3% of the full relaxation strength

Time scale and dynamics



□: shear mechanical alpha relaxation, ○: dielectric Debye-like relaxation, ◇: dielectric alpha relaxation. **Open symbols** 2-butanol, **Closed symbols**: 2-ethyl-1-hexanol.

	T_g		m	
	Shear Alpha	Dielectric Debye-like	Shear Alpha	Dielectric Debye-like
2-butanol	120K	130K	63	29
2-ethyl-1-hexanol	144K	158K	60	30

Conclusions

- Shear-mechanical generic glass-former
- Time scale of dielectric non-Debye peak closely follows mechanical alpha relaxation
- Fragility and T_g depend strongly on kind of relaxation
- If mechanical signature of dielectric Debye-like relaxation exists it is very soft.

References

T. Christensen & N. B. Olsen, A rheometer for the measurement of a high-shear modulus covering more than 7 decades of frequency below 50 khz. *Rev. Sci. Instrum.*, **66**, 5019, 1995.

B. Jakobsen, C. Maggi, T. Christensen & J. C. Dyre, Investigation of the shear-mechanical and dielectric relaxation processes in two monoalcohols close to the glass transition. *J. Chem. Phys.*, **129**, 184502, 2008.