Electronic Supplementary Information (ESI)

on

Influence of Electric Potential on the Apparent Viscosity of an Ionic Liquid: Facts and Artifacts

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1. About this ESI

In the paper associated with this ESI,† we present our findings from cone-on-plate viscometry of the ionic liquid [Emim][Tf2N] under external electric potential. We show that, if a sliding wire is used to contact the WE of the system, measurement artifacts can occur that are easily mistaken for a systematic change in viscosity. Detailed analysis provides evidence that the artifact is caused by the passage of current through the sliding contact.

In this ESI, we give further insights into the experimental setup and present additional experimental results.

2. Further Details Experimental Setup

2.1. Comparison with the Experiment of Dold et al.

To allow for easy comparison between our measurements and those of Dold et al.,[1] Tab. 1 summarizes the key differences between the two experimental setups.

2.2. Electrode Design

For our experiments, two different electrode designs were used as shown in Fig. 1. Both designs are based on copper-coated printed circuit board (PCB). No difference in system behavior was observed between the designs, hence they were used interchangeably.

2.3. Simplified Electric Circuit

A schematic drawing of the simplified electric circuit mentioned in Section P-4 is shown in Fig. 2. Here, the gap between the rotating plate and the stationary plate is not filled with IL, but with ambient air. A second sliding wire is used to close the electric circuit.

Tab. 1 Comparison of experimental setup and procedure for rotational viscosity measurements. No information was available on entries marked with 'n/a'. Differences in cleaning procedure are not listed.

Parameter	Ploss et al.	Dold et al.[1]
plate diameter	20 mm	25 mm
cone angle	0°	0°
gap height	0.5 mm	0.8 mm
temperature	25 °C	25 °C
max. shear rate	300 s^{-1}	50 s^{-1}
WE material	stainless steel	stainless steel‡
CE material	copper	platinum
pseudo-RE material	copper	platinum
contact to WE	sliding wire	n/a
type of measurement	relative change	n/a
potential ramp	instantaneous	n/a

† references to the main paper are marked with "P" in the following

‡ the WE material is not explicitly stated in case of the viscosity measurements. However, the remainder of the paper suggests that a stainless steel WE was used.

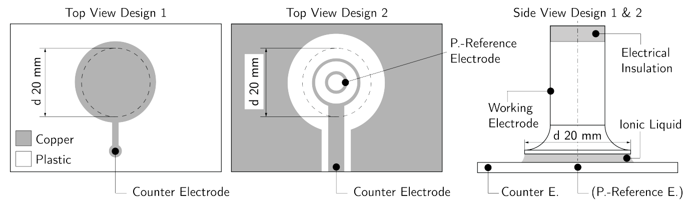

Fig. 1 Three- and two-electrode setup based on copper-coated printed circuit board. Both designs were used interchangeably since no difference in system behavior was observed.

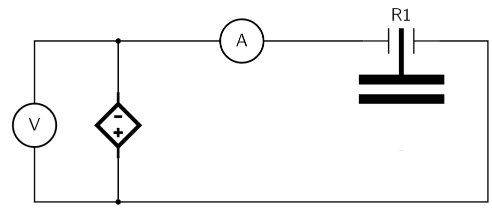

Fig. 2 Simplified electric circuit with two sliding wires at the rotating plate. R_1 is the combined resistance of both wires. Note that the gap between the two plates is filled with ambient air, not IL.

3. Further Experimental Results

Fig. 3 shows that, in case of the single-strand copper wire, the viscosity signal is not affected by the application of external electric potential for short run-in times.

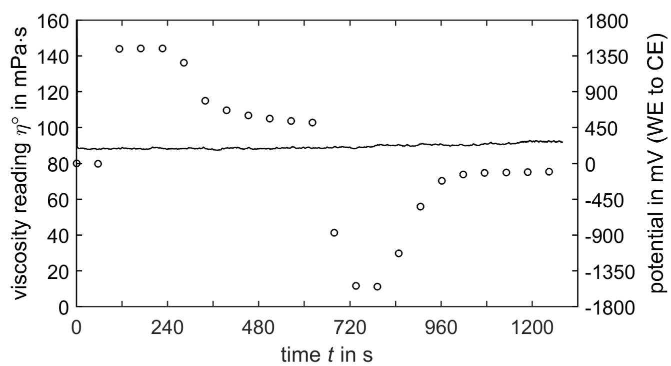

Fig. 3 Viscosity reading (—) as a function of time and potential (○). The experiment (copper wire) was carried out after a run-in time of less than 1 h. No changes are observed for potentials of ±1650 mV, the slight upwards trend of the viscosity reading is caused by a long-range fluctuation in wire-induced friction.

References

1 C. Dold, T. Amann and A. Kailer, *Phys. Chem. Chem. Phys.*, 2015, **17**, 10339–10342.