

Works on electric field cell with external electrodes

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Task 2: “Kinetics and Dynamics”

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Plan

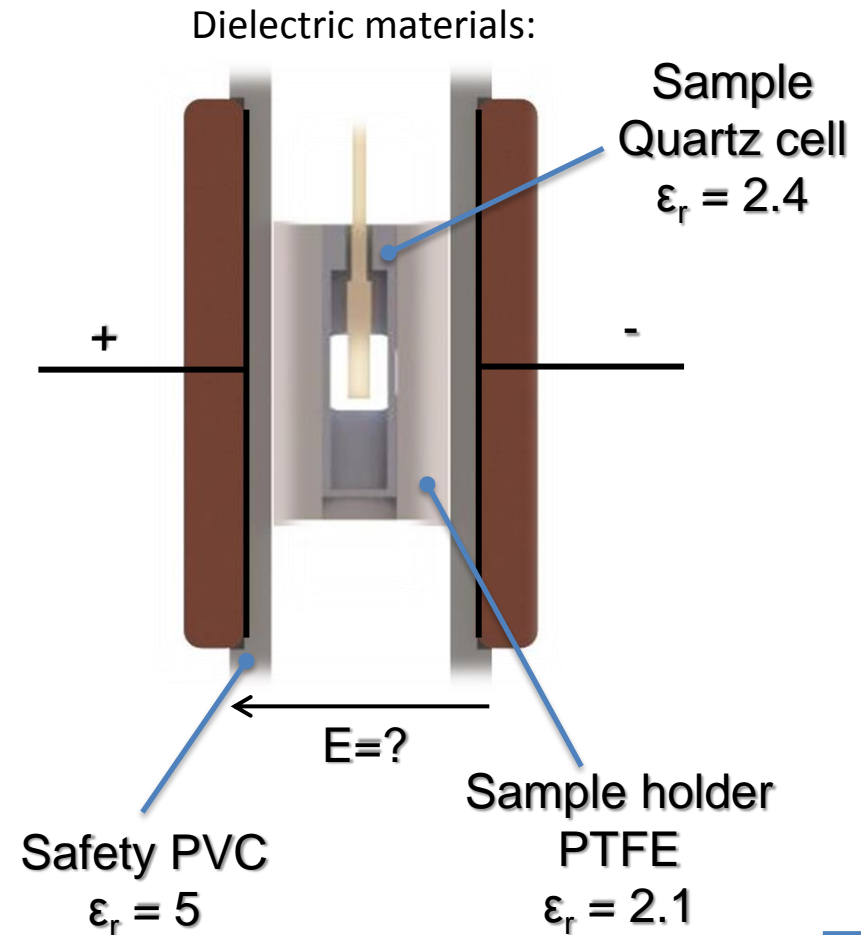
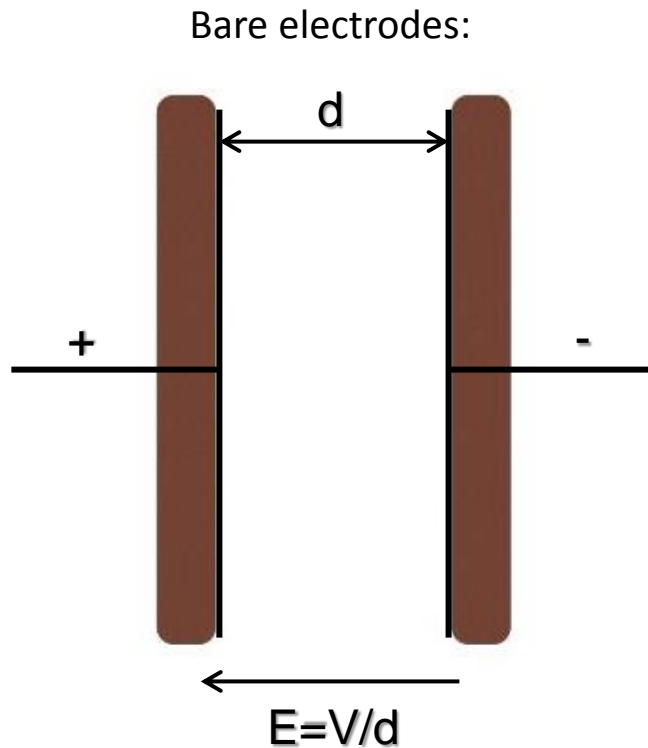
- Actual electric field cell
- Electric field measurements carried out
- A new design
- Visit at HZB

Bibliography

- Range of electric field :
From 0.04 to 4 kV/cm
- Range of frequency
From 0 to 60 kHz
- Range of temperature
From 20 to 60 °C

Actual electric field cell

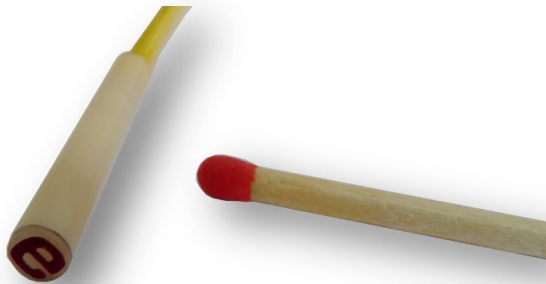
Review



Electric field measurements carried out

kaptens : An Electro-Optic probe to measure High Electric Fields

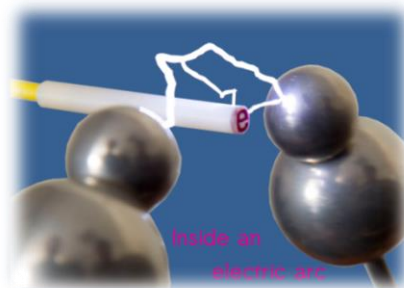
- In-situ measurements inside fluids
- E-field measurement without perturbation induced by the sensor
- Small size ($\varnothing 4\text{mm}$) ; Slightly larger than a matchstick
- Pockels effect (birefringence proportional to the electric field)
- From 10Hz to 18GHz bandwidth



The probe (left) compared with a matchstick (right)



The measuring instrument



Electric field measurements carried out

Performed measurements in different fluids to test the electric field

- From 0.1 kV to 2 kV at 10 kHz
- 2.5 cm electrode spacing
- Hellma cell (type 110-5-40) 5 mm sample thickness
- Sample holder made from PTFE

Fluid	Permittivity ϵ_r
Air	1.0
Toluene	2.3
Ethanol	24.3
DMSO (Dimethyl sulfoxide)	46.7
Distilled water	78.6
Tap water	80.0



Electric field cell in the 25mm space configuration

Electric field measurements carried out

Performed measurements in different fluids to test the electric field

- From 0.1 kV to 2 kV at 10 kHz
- 2.5 cm electrode spacing
- Hellma cell (type 110-5-40) 5 mm sample thickness
- Sample holder made from PTFE

Fluid	Permittivity ϵ_r	Electric field (kV/cm)
Air	1.0	3.07E-1
Toluene	2.3	2.45E-1
Ethanol	24.3	2.36E-2
DMSO (Dimethyl sulfoxide)	46.7	5.32E-3
Distilled water	78.6	2.72E-3
Tap water	80.0	5.20E-4

Electric field in different fluids with an applied voltage of 2kV at 10kHz at 20°C

Remark 1: Without dielectrics the electric field would be equal to 0.8kV/cm

Electric field measurements carried out

Influence of the permittivity of the sample holder on the measurement

- From 0.1 kV to 2 kV at 10 kHz
- 3.8 cm electrode spacing
- Hellma cell (type 110-5-40) 5 mm sample thickness
- Measurements with PVC ($\epsilon_r = 5$) and PTFE ($\epsilon_r = 2,1$) sample holder and toluene sample

Material	Permittivity ϵ_r	Electric field (kV/cm)
PTFE (Teflon)	2.1	0.155
PVC	5.0	0.165



Sample holder in PVC on the EFC and the sample holder in PTFE (behind)

A new design

A closed cell and thermalized

- Cooling system on the electrodes to thermalize the sample



- Closed cell for the safety and less dielectrics



A new design

A closed cell and thermalized

- Cooling system on the electrodes to thermalize the sample
- Closed cell for the safety and less dielectrics

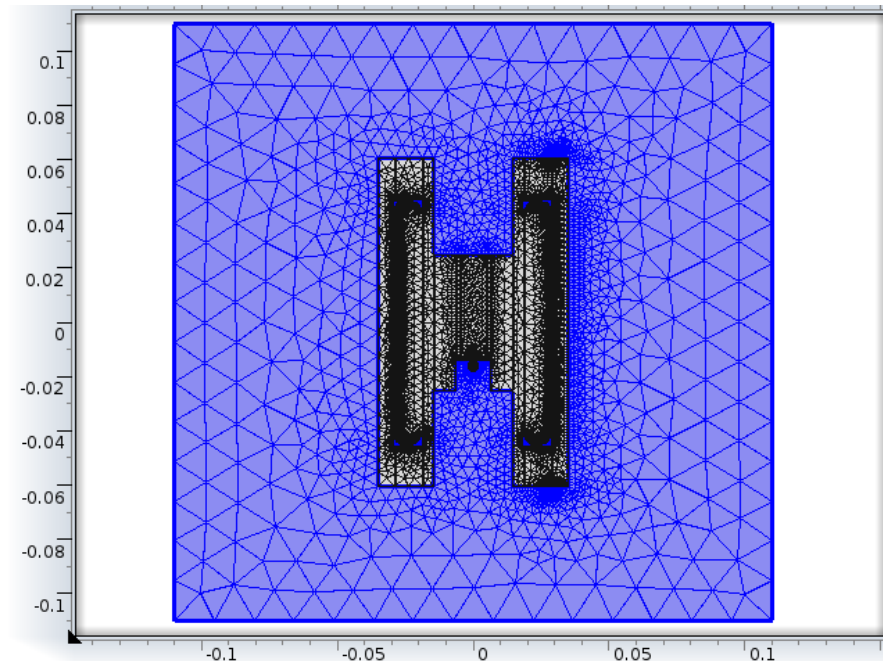


Visit at HZB

Simulations with COMSOL Multiphysics

Comparison between measurements with Kapteos's probe and simulation with toluene

Mesh for simulations



Conclusions

- Actual electric field cell for samples with low permittivity
- New design + simulations

Conclusions

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Thank you for your attention !