Works on electric field cell with external electrodes

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Works on electric field cell with external electrodes

Electric field cell : review

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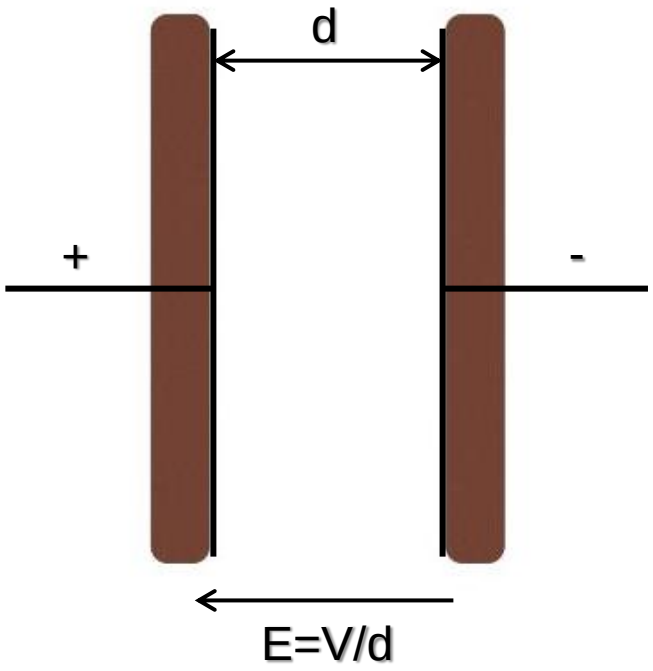
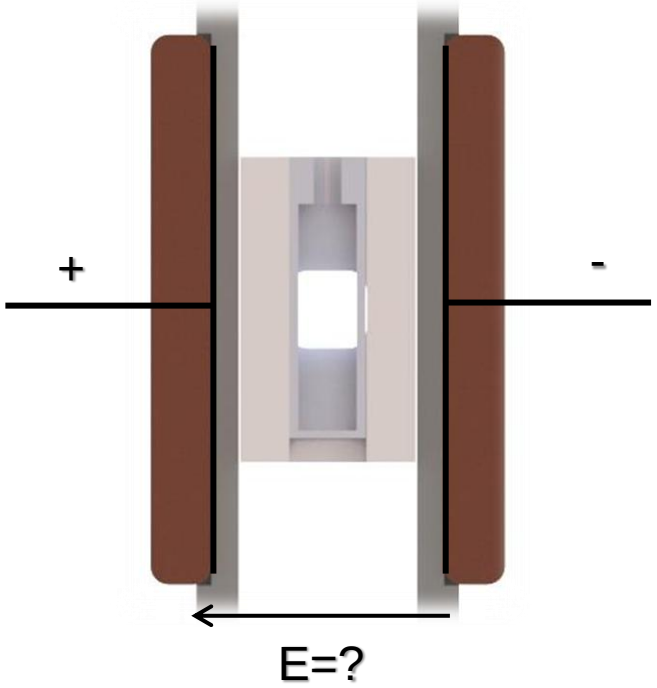
Electric field cell : review

Bare electrodes:



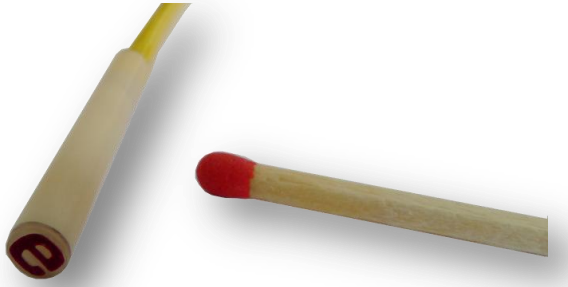
Dielectric materials:



Electric Field measurements

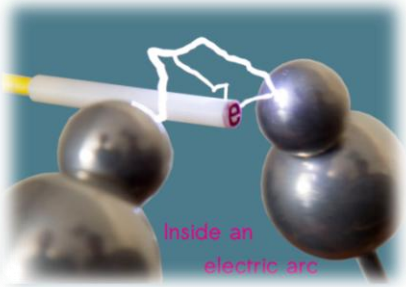
kapteos : An Electro-Optic probe to measure High Electric Fields

- In-situ measurements inside fluids
- E-field measurement without perturbation induced by the sensor
- Small size (Ø4mm) ; 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

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

The experiment with the electric field cell (center)

Probe inside the sample

Electric Field measurements

Performed measurements in different fluids to test the electric field cell

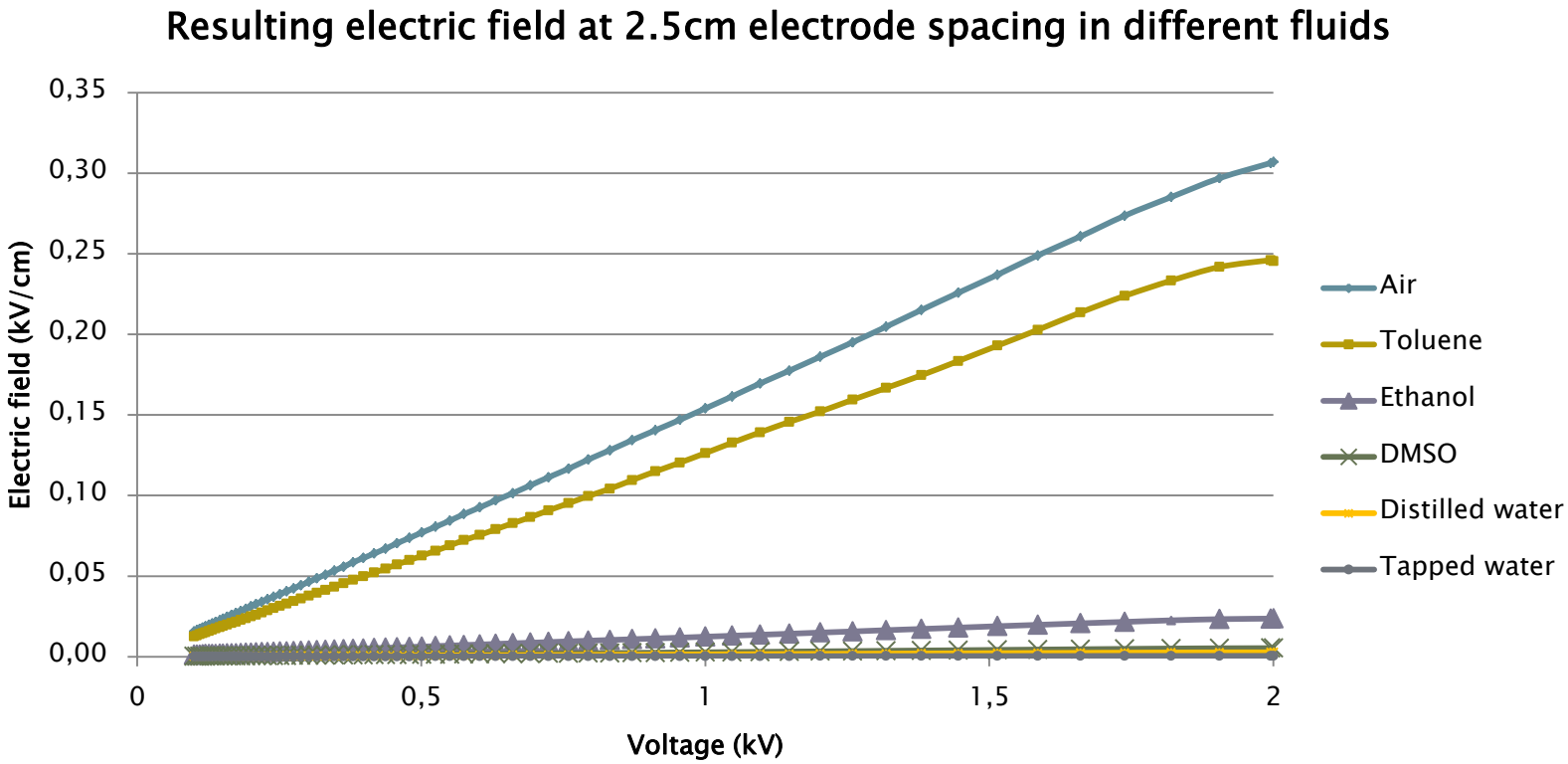
- From 0.1kV to 2kV at 10kHz
- 2.5cm electrode spacing
- Hellma cell (type 110-5-40) 5mm sample thickness

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

Electric field cell in the 25mm space configuration

Electric Field measurements

Performed measurements in different fluids to test the electric field cell



The higher the electric field, the lower the permittivity

Electric Field measurements

Performed measurements in different fluids to test the electric field cell

Fluid	Permittivity ε_r	Electric field (kV/cm)
Air	1.0	0.307
Toluene	2.3	0.245
Ethanol	24.3	23.6E-3
DMSO (Dimethyl sulfoxide)	46.7	5.32E-3
Distilled water	78.6	2.72E-3
Tapped water	80.0	0.52E-3

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

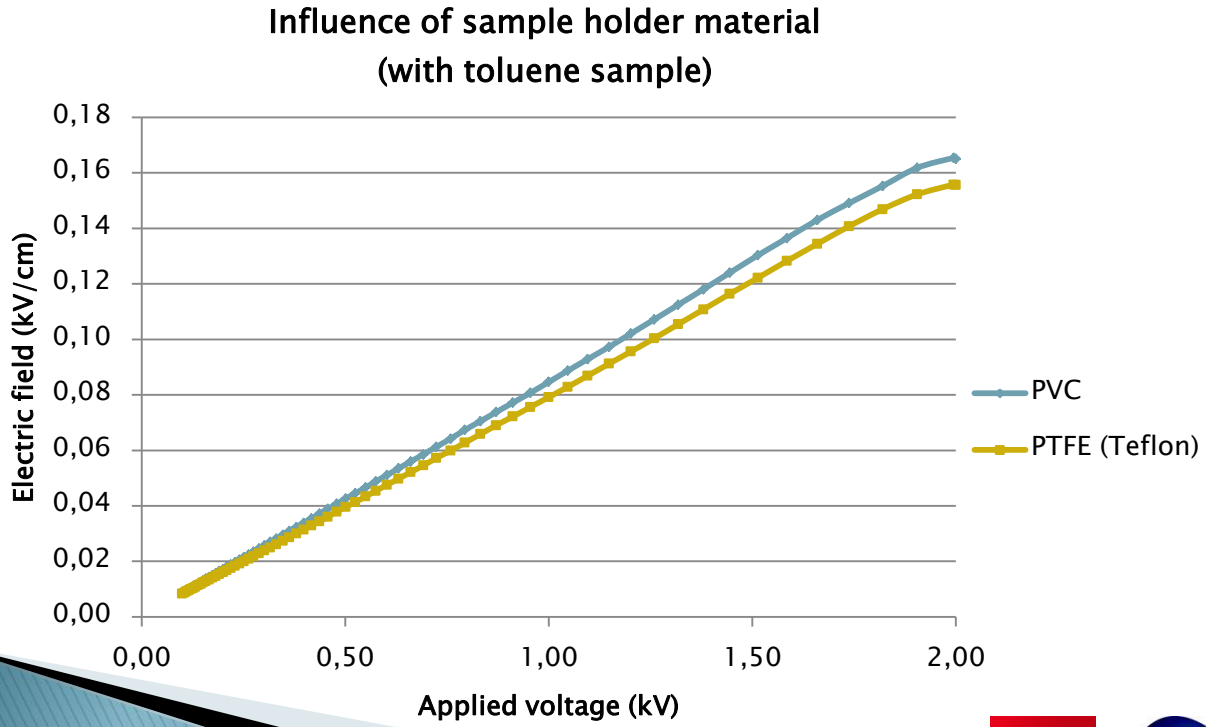
Remark 1:Without dielectrics the electric field would be equal to 0.8kV/cm

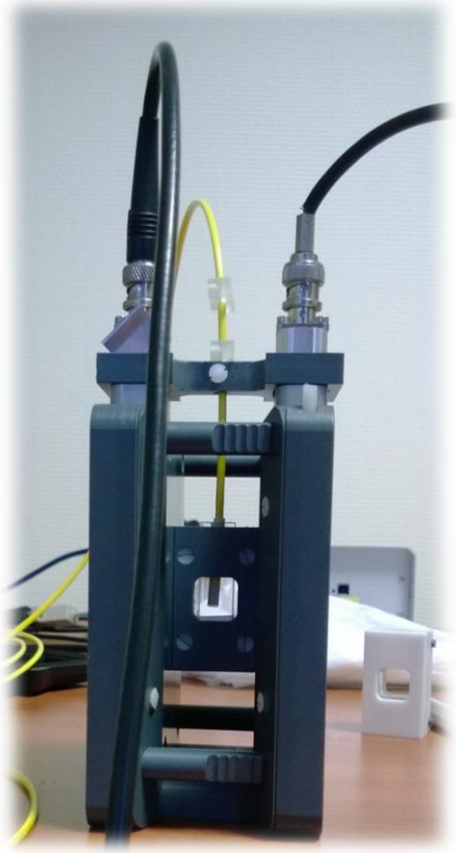
Remark 2:the permittivity is temperature dependent!

Electric Field measurements

Influence of the permittivity of the sample holder on the measurement

- Measurements with PVC (ϵ_r=5.0) and PTFE (ϵ_r=2.1) sample holder and toluene sample
- From 0.1kV to 2kV at 10kHz
- 3.8cm electrode spacing





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

Electric Field measurements

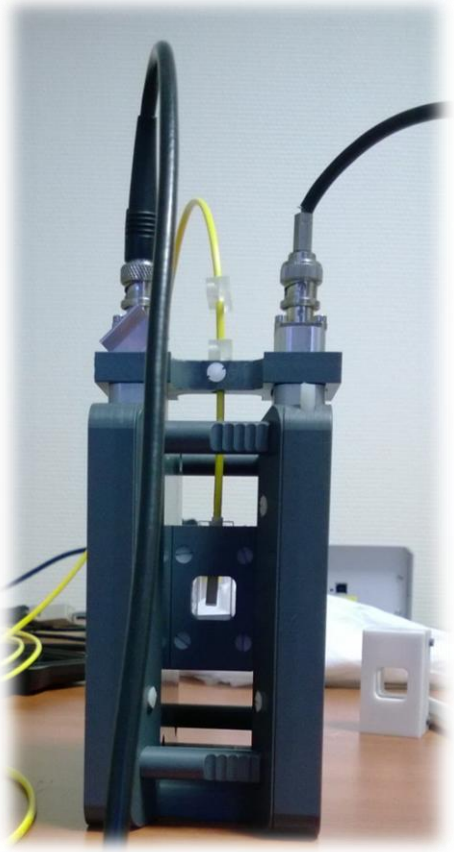
Influence of the permittivity of the sample holder on the measurement

- Measurements with PVC (ϵ_r=5.0) and PTFE (ϵ_r=2.1) sample holder and toluene sample
- From 0.1kV to 2kV at 10kHz
- 3.8cm electrode spacing

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

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

Remark :without dielectrics the electric field would be equal to 0.526kV/cm



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

Electric Field measurements

Material importance

In presence of different dielectric materials between the electrodes their respective permittivity play an important role.
The ratio between each material permittivity will determine the finally applied electric field.

The best measurement configuration will be to have an electrode isolation material with the same permittivity as the sample.

Due to our neutron scattering, the presence of a quartz cell is necessary. The permittivity of quartz (ϵ_r=4) and the surrounding air will always reduce the effective electric field.

Conclusion

The materials of the electric field cell must be selected to minimize the screening effect.

Therefore, we can imagine different electric field cells with different materials to approach each sample permittivity.

The next step will be to find and test these materials, make measure at the LLB and study the thermalization with Comsol Multiphysics® simulation software.

Thanks

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