

Electric field cell for SANS



General JRA Meeting

15th October 2014 Eynsham Hall, UK

Task2: “Kinetics and Dynamics”

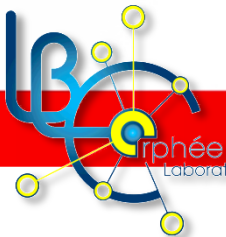


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Laboratoire Léon-Brillouin

NMI3-FP7-JRA-II-WP20 “Advanced neutron tools for Soft and Bio-Materials”



Bibliography

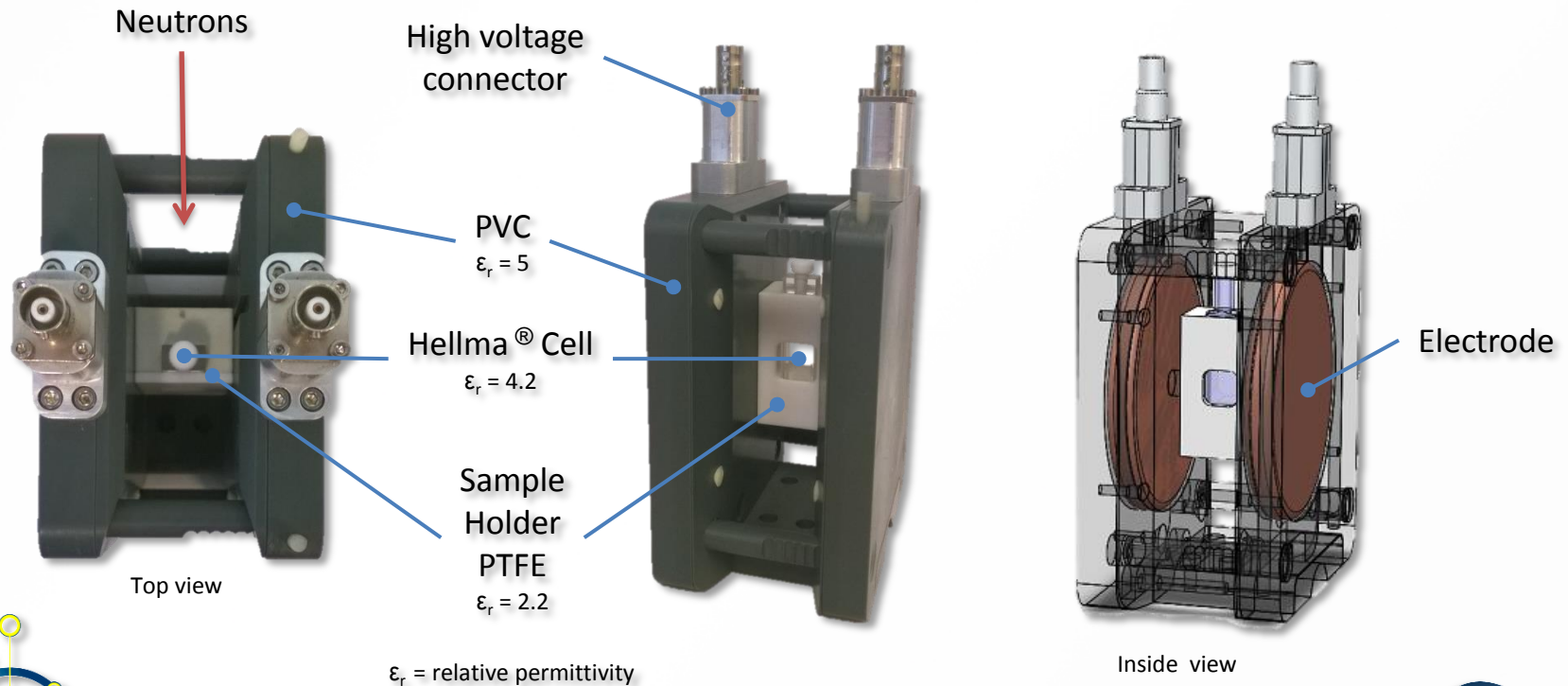
In the literature, the most commonly used configurations are:

- Range of electric field:
From 0.04 to 4 kV/cm
- Range of temperature:
From 10 to 60 °C
- Range of frequency:
From 0 to 60 kHz

Actual design

Prototype of the electric field cell

- External electrodes
- Rectangular and circular Hellma[®] cells
- Easy to use

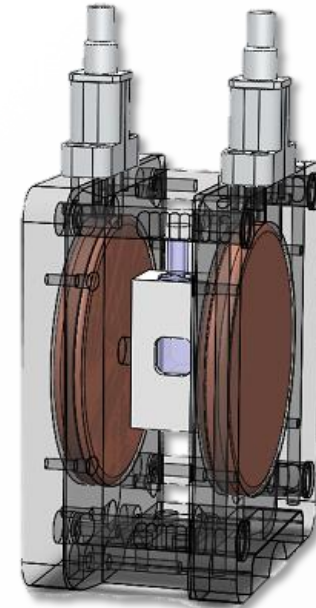
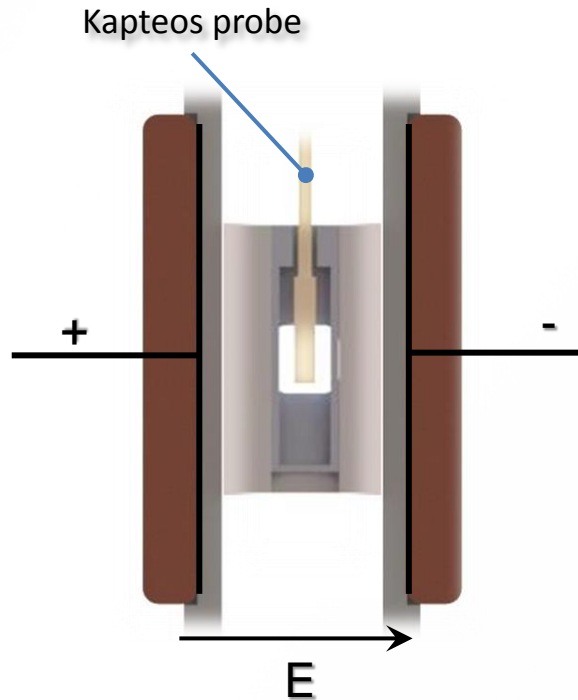


Actual design

How to measure the high electric field inside the sample?

Difficulty due to dielectric materials

- External electrodes
- Rectangular and circular Hellma[®] cells
- Easy to use



Actual design

Measurements

kapteos probe's to measure high electric field inside a fluid

Measurements performed in different solvents:

| 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 |

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

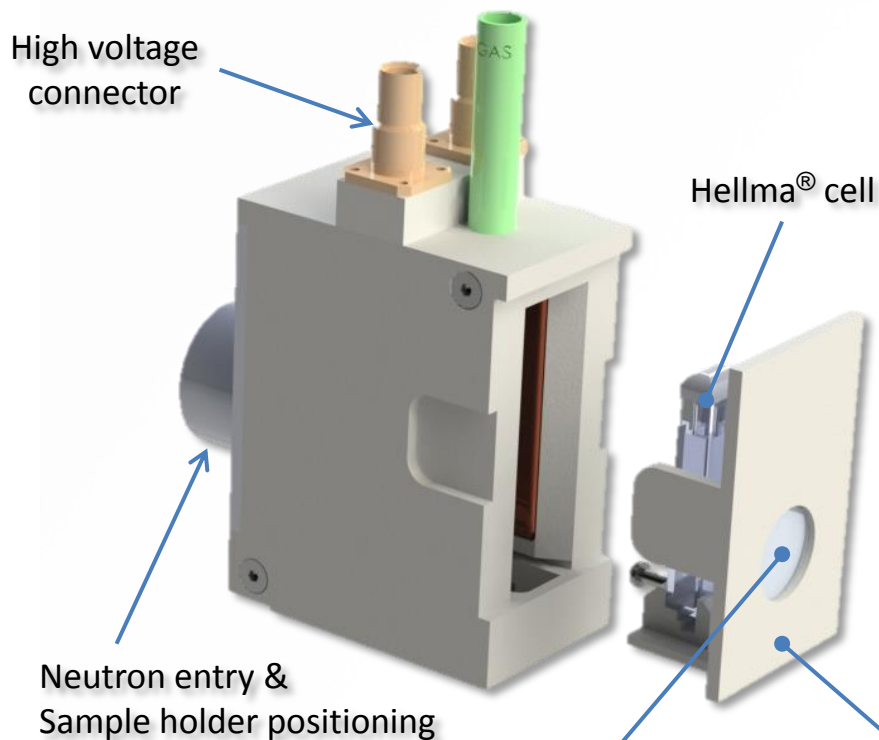
Due to a large amount of dielectric materials, the electric field is actually too weak.



Kapteos probe inside an Hellma® cell

Toward a new design

Closed and thermalized



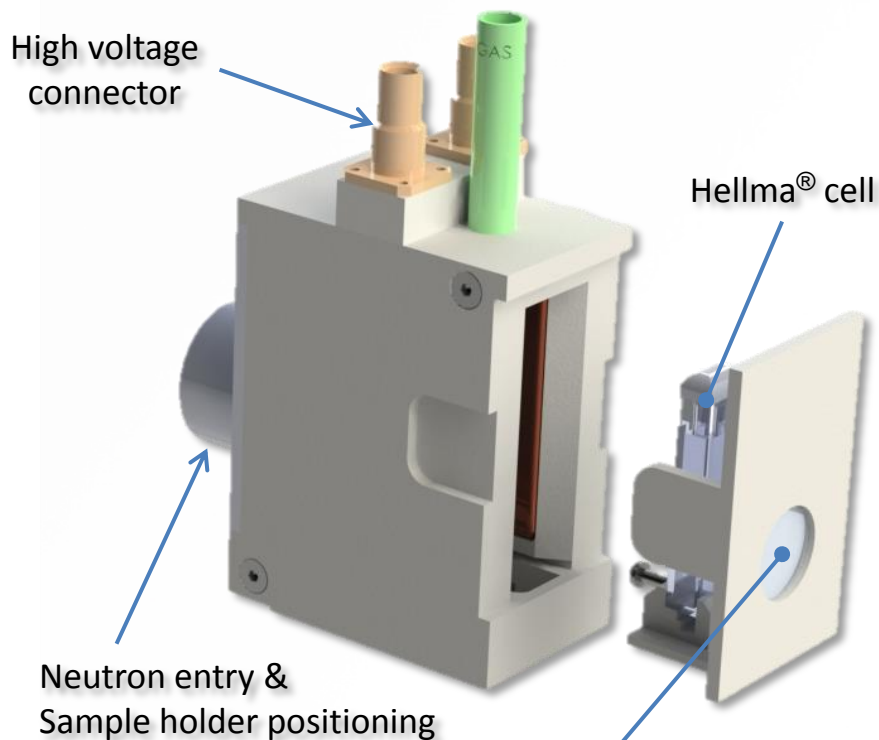
- Closed electric field cell
- **Less dielectric materials** between electrodes
- Spacing between electrodes is reduced
- Rectangular Hellma® cell using
- Sample thermalization from 10 to 60 °C (due to PVC)

Sample holder for Hellma® cell
(1, 2 or 5mm thickness)

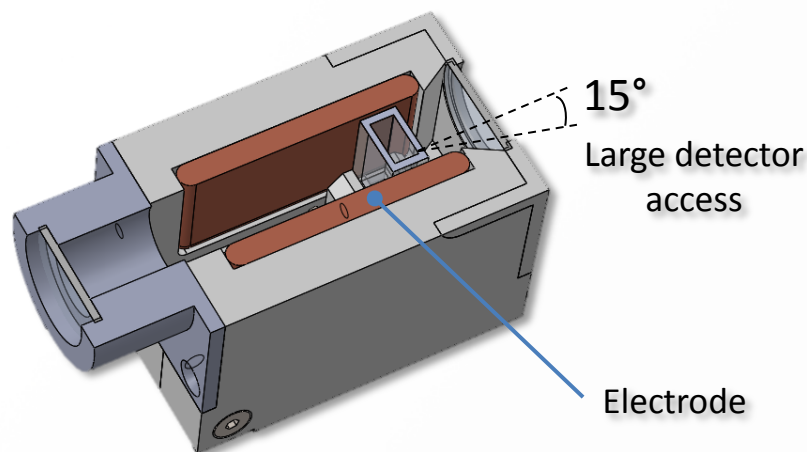
Quartz windows are not used at room temperature

Toward a new design

Closed and thermalized



- Closed electric field cell
- **Less dielectric materials** between electrodes
- Spacing between electrodes is reduced
- Rectangular Hellma® cell using
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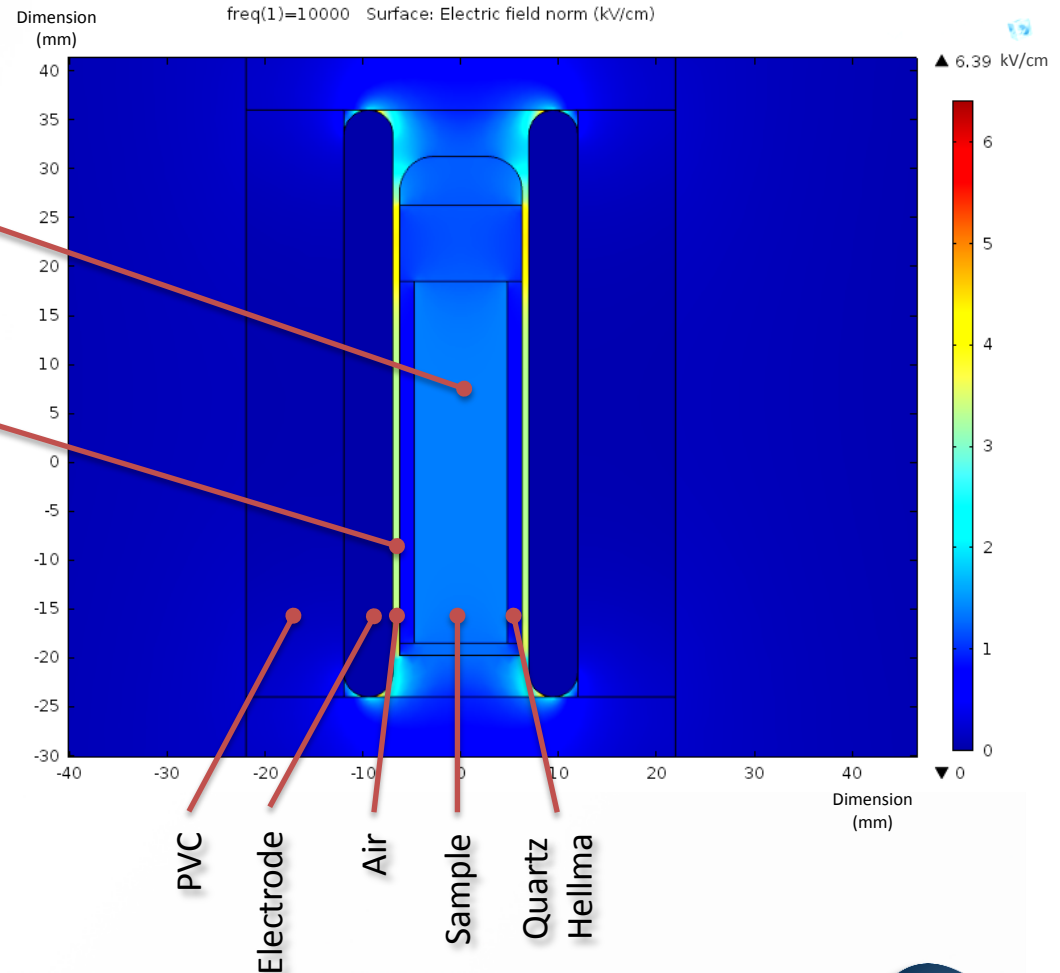
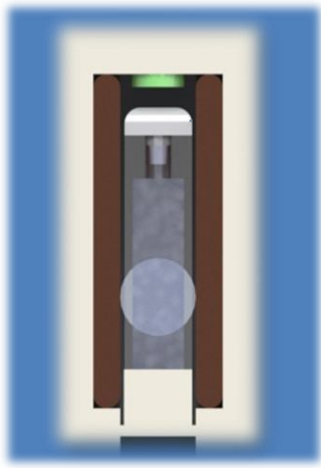
Quartz windows are not used at room temperature.

Toward a new design

Simulation

Electric Field Simulation

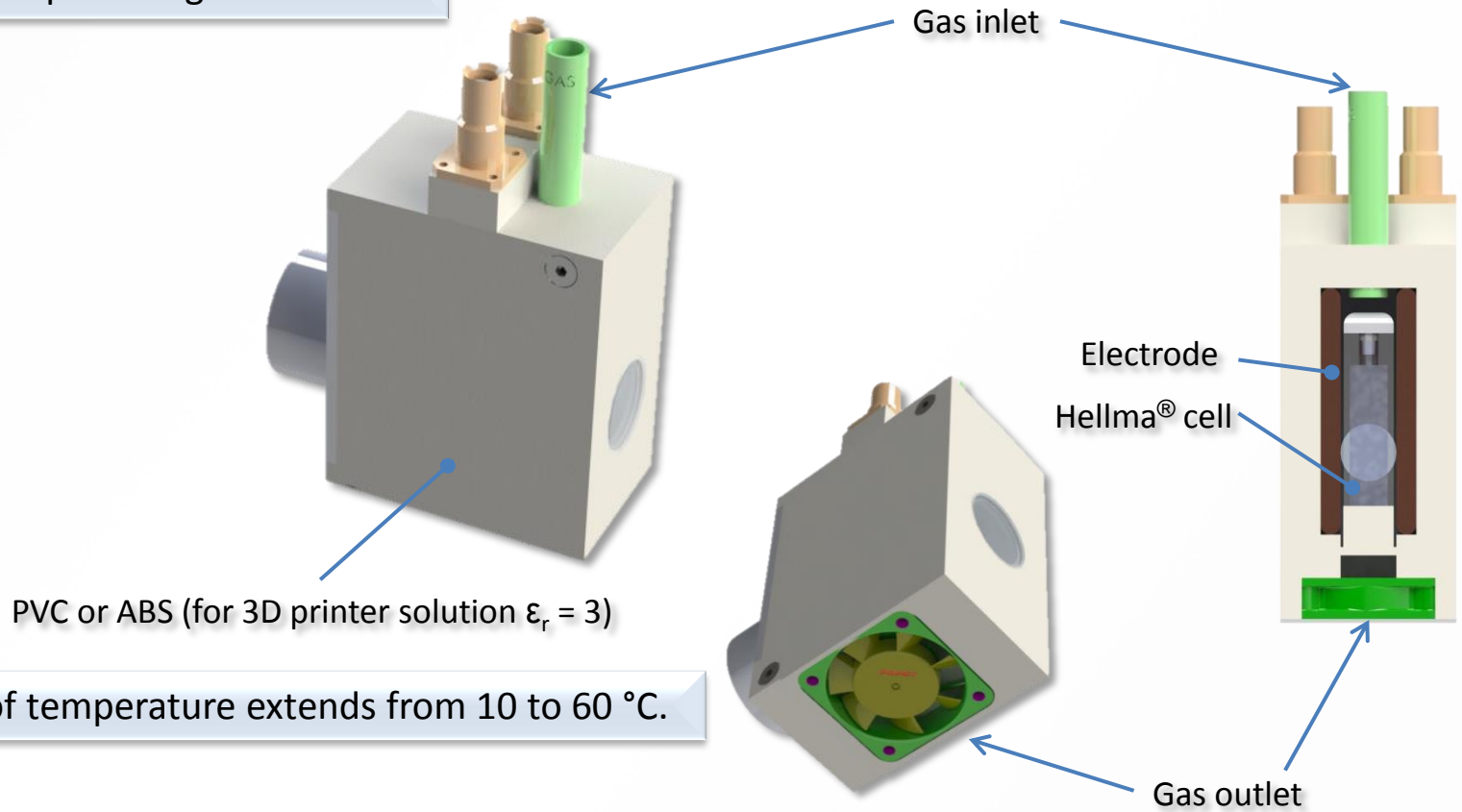
- Sample thickness 9.6mm
1.4 kV/cm on the sample
(toluene $\epsilon_r = 2.3$) with 2kV applied
- The EF can be improved
reducing the spacing between the
electrodes and the Hellma[®] cell



Toward a new design

Thermalization

The sample is heated by using a stream of tempered gas.



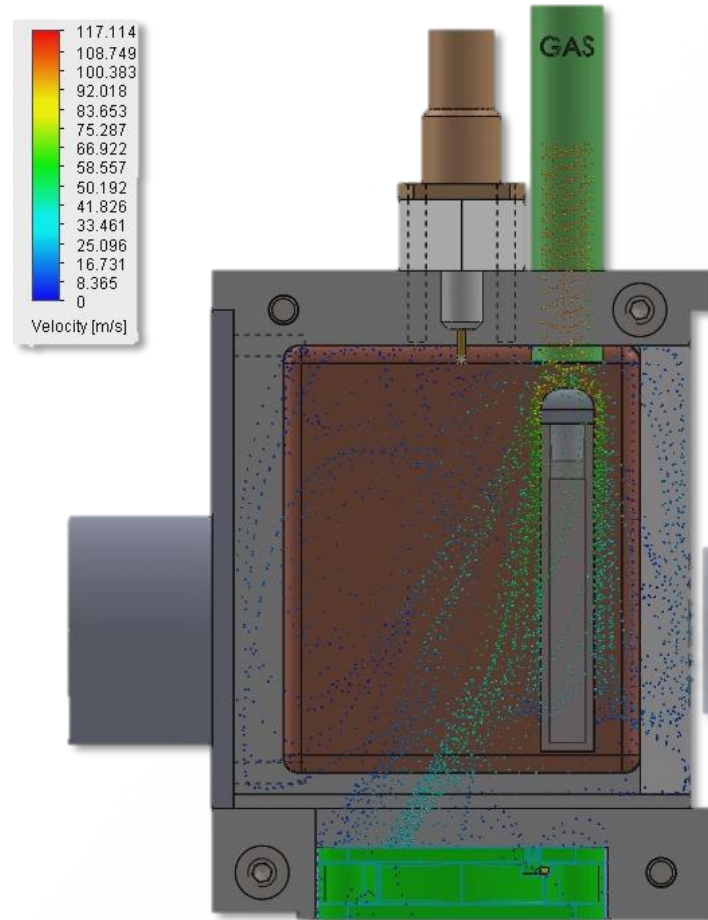
The range of temperature extends from 10 to 60 °C.

Toward a new design

Thermalization

Gasflow simulation

- Homogeneous flow on the sample
- Reduction of the front turbulences?

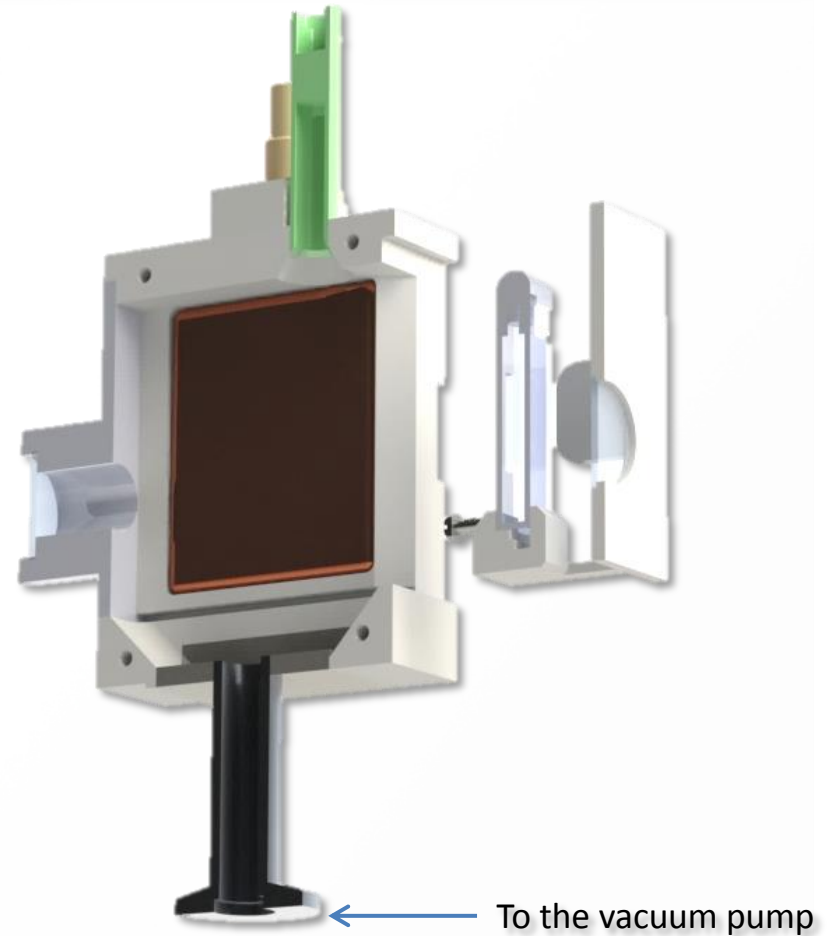
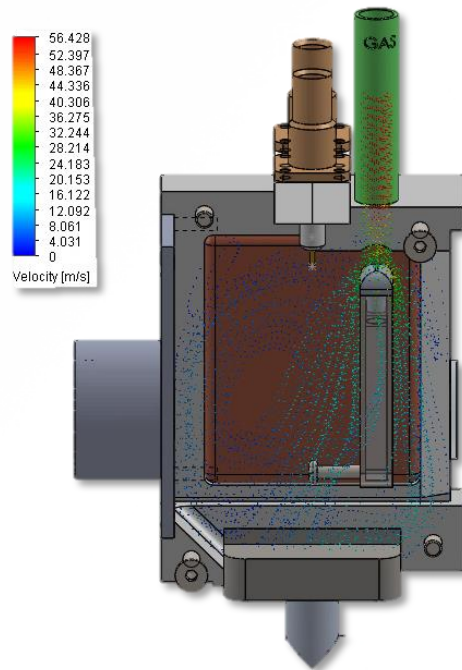


Toward a new design

Thermalization

Gasflow regulation with a vacuum pump

Use of vacuum pump to define airflow.
The opening of the valve will determine the gasflow.



Thanks



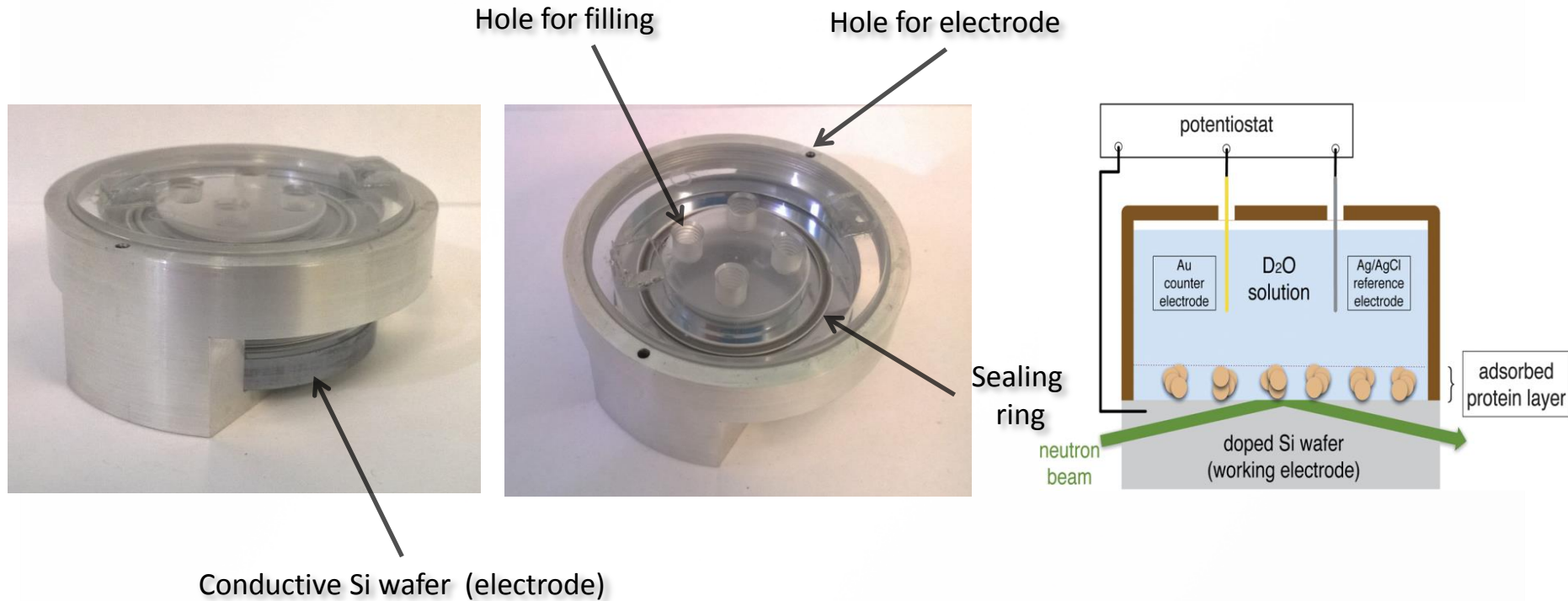
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Electric field cell for neutron reflectometry

Task1: a platform for model biological membranes



A. Koutsioubas et al., *Soft Matter*, **2012**, *8*, 2638-2643

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Thank you for your attention