Hochschule Zittau/Görlitz
UNIVERSITY OF APPLIED SCIENCES

Fachgebiet
Hochspannungstechnik /
Werkstoffe der Elektrotechnik /
Theoretische Elektrotechnik

Impactof Contact Pressure on Space Charge Measurement in Silicone Elastomers

CSI Burghausen | May 2026

Content of the Presentation

1. Motivation
2. Experimental Setup
3. Results
4. Summary and Outlook

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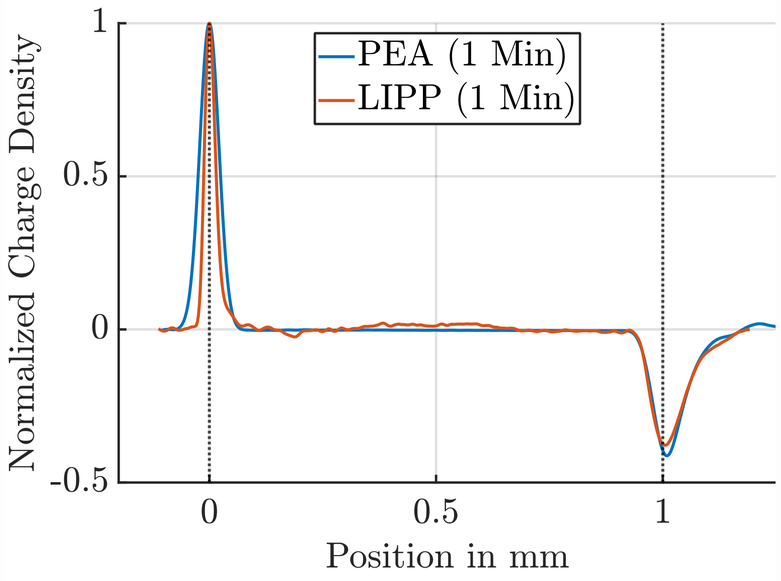
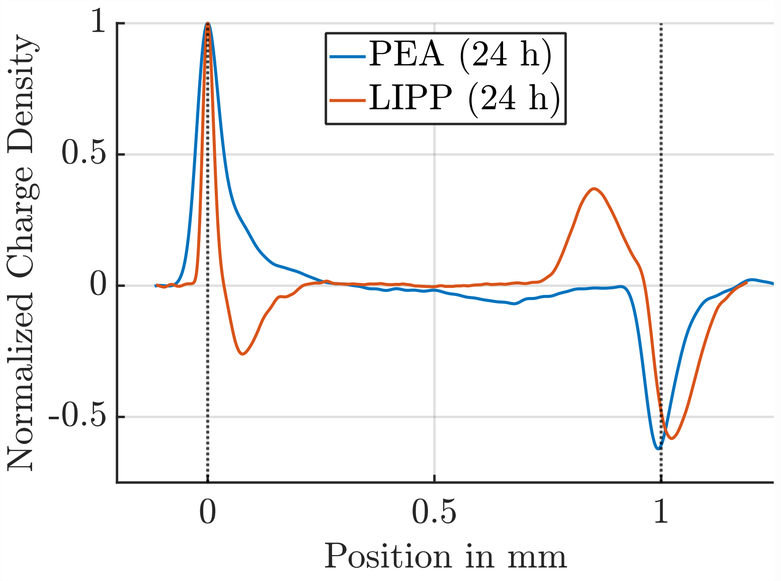
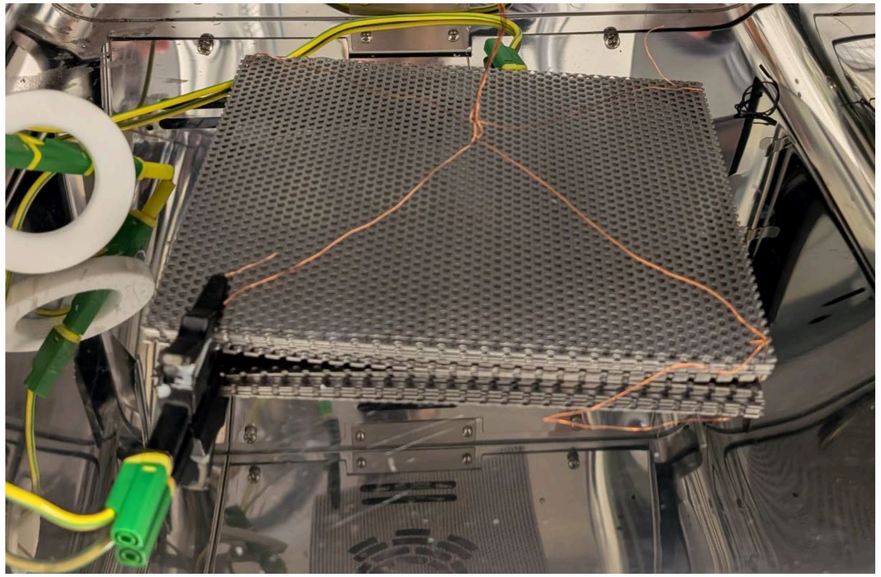
Comparability between LIPP and PEAresults

- Comparison of noramlised space charge profiles of LR 3003/80 measured with LIPP and PEA
- Homocharges in PEA-Setup and Heterocharges in LIPP-Setup
- Different contact pressure possible reason



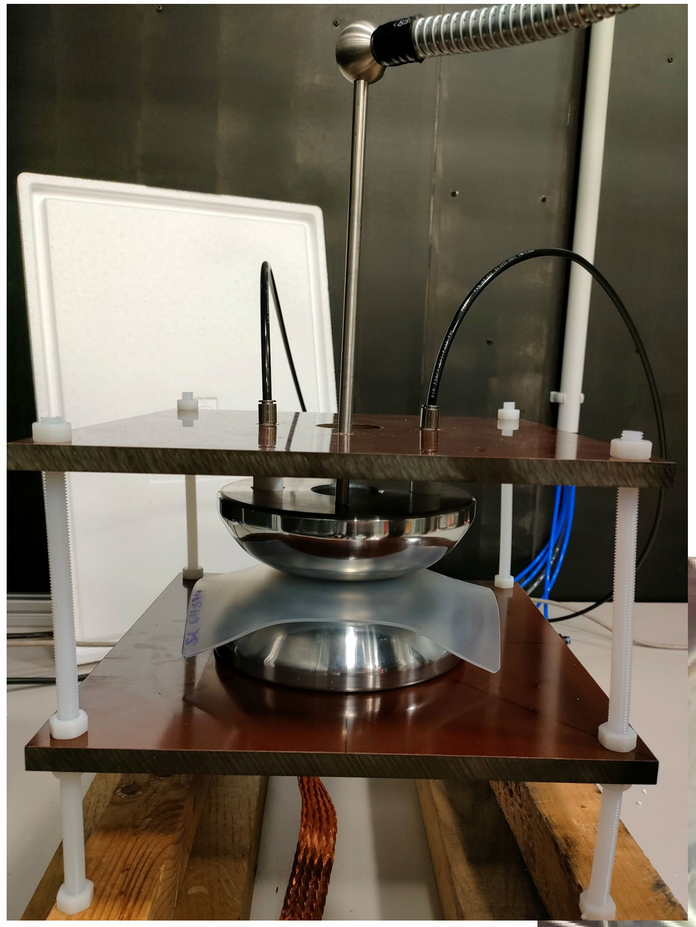


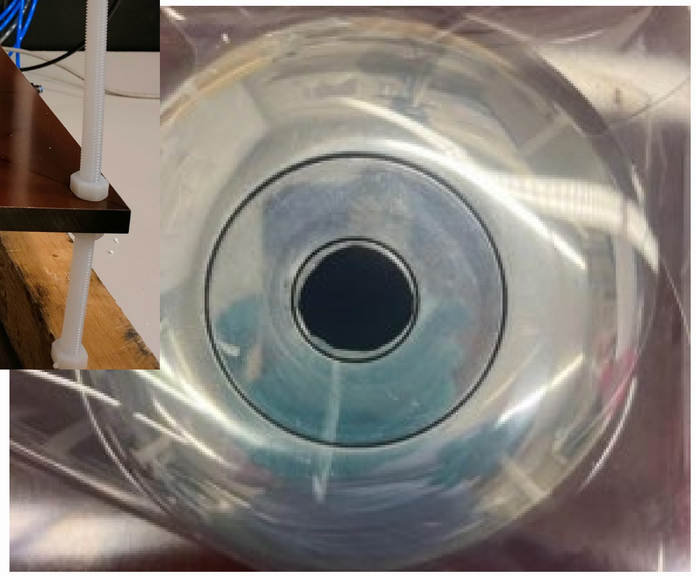
Preparation of samples

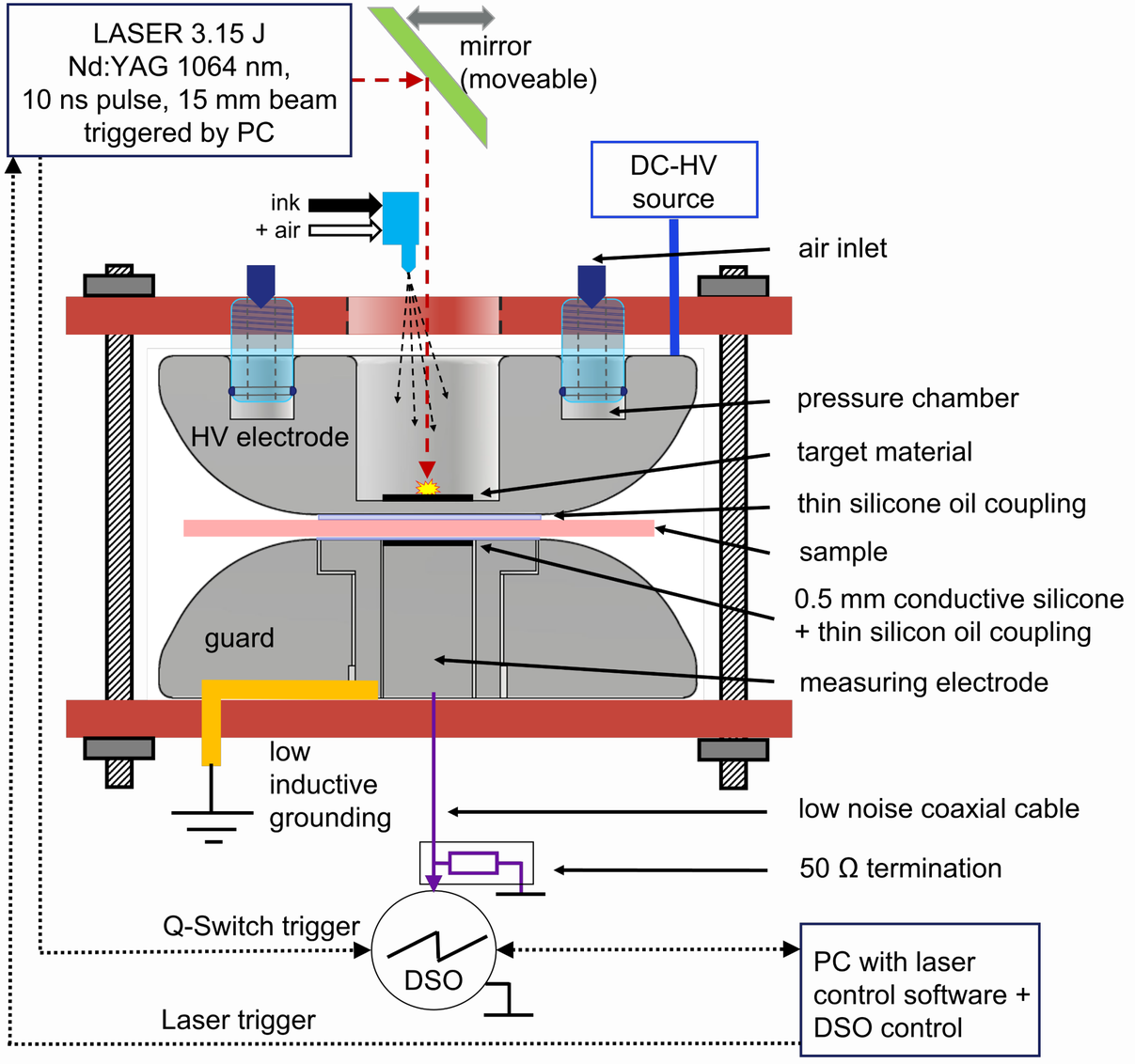


1. **Grounding** and **short circuiting** at **70 °C for 7 days** to degas and discharge deeply trapped charges
2. Acclimatise at **room climate for 24 h**
3. **Cleaning** samples and **mounting in electrode setup**
4. **Grounding** whole setup **for 24 h**

Setup

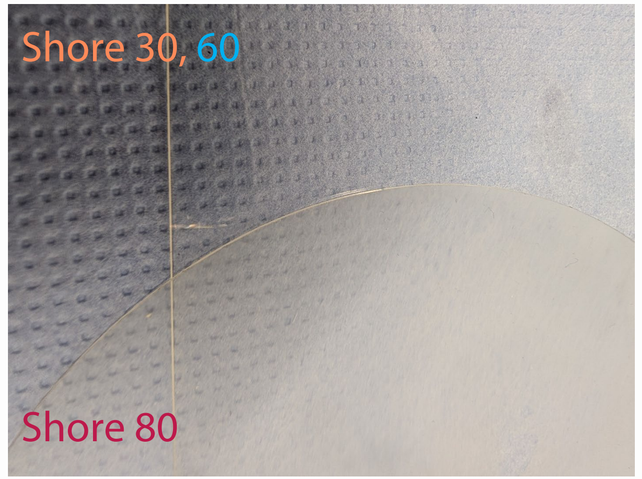


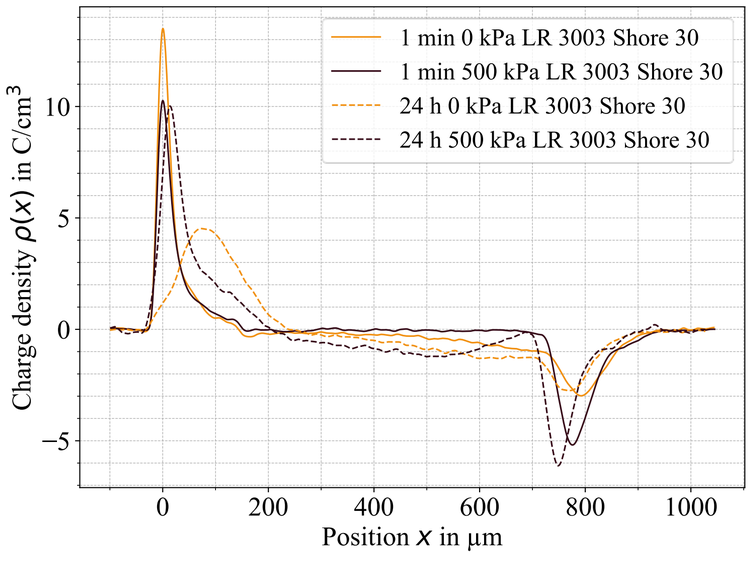


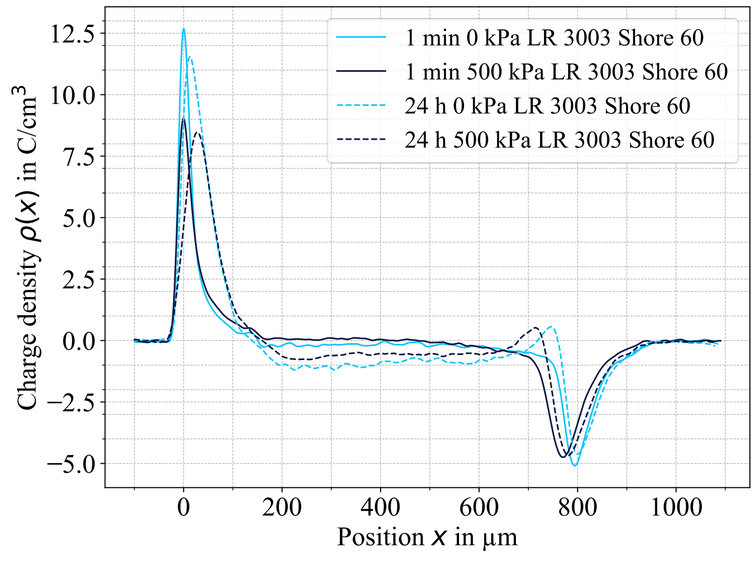

LASER 3.15 J
Nd:YAG 1064 nm,
10 ns pulse, 15 mm beam
triggered by PC
mirror
(moveable)
DC-HV
source
ink
+ air
air inlet
HV electrode
pressure chamber
target material
thin silicone oil coupling
sample
0.5 mm conductive silicone
+ thin silicon oil coupling
guard
measuring electrode
low
inductive
grounding
low noise coaxial cable
50 Ω termination
Q-Switch trigger
DSO
PC with laser
control software +
DSO control
Laser trigger

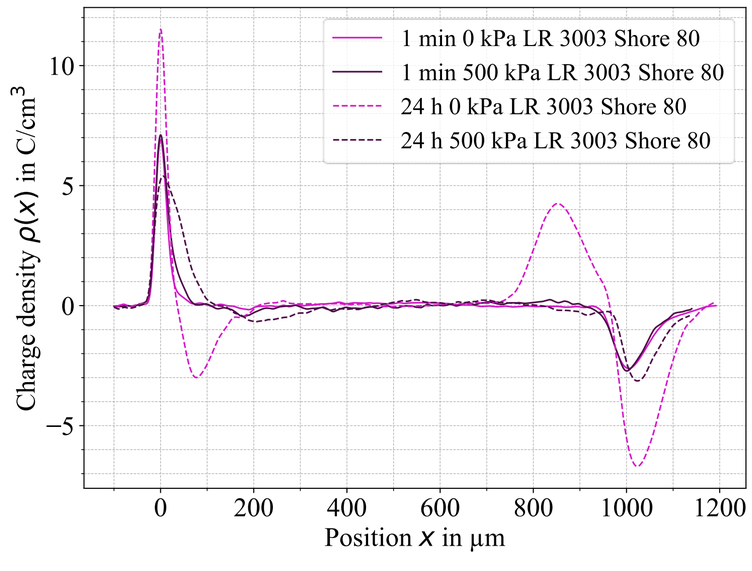
Experiments with silicones of different Shore A hardness

- DC voltage for **E = 10 kV/mm**
- Contact pressure with controled air pressure: **500 kPa**
- Measurements at **1 min** and after **24 h**
- Samples: Wacker **LR 3003, Shore A 30, 60, 80** (0,8 mm and 1,0 mm)
- Reference: PE 300
- Room climate
- All Measurements **conducted three times**



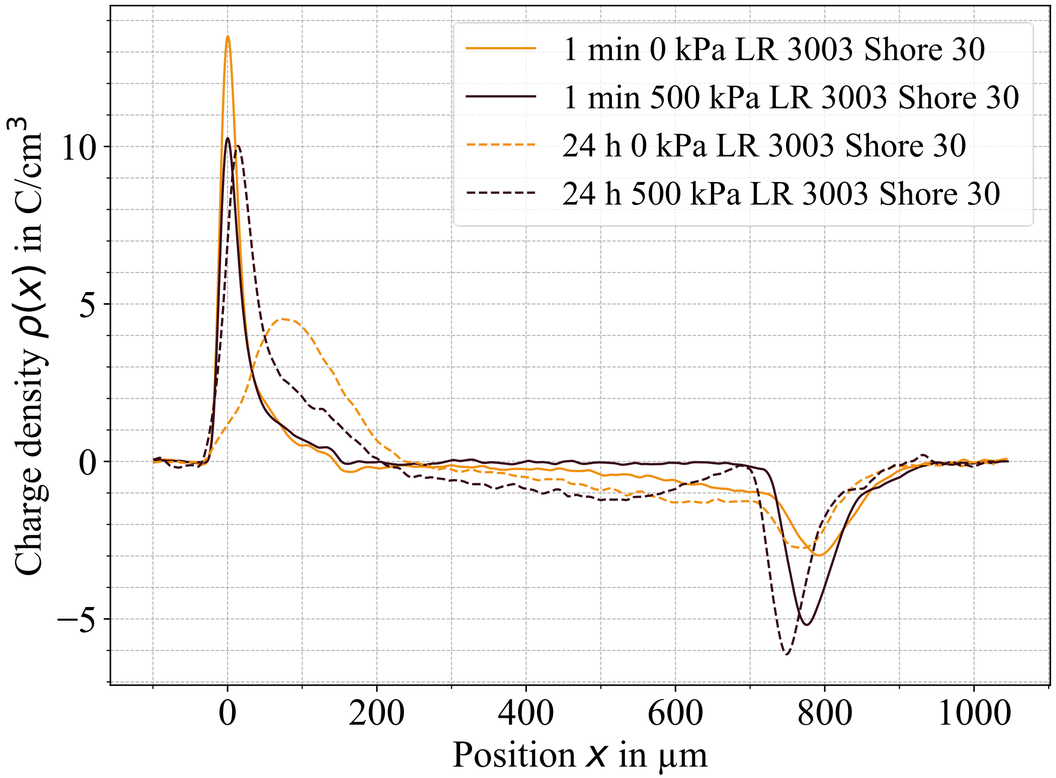


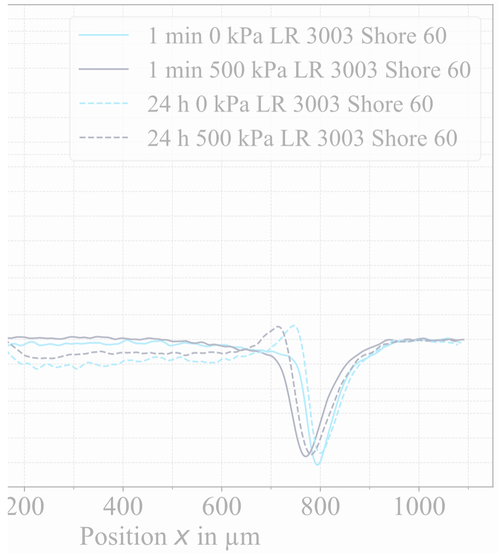


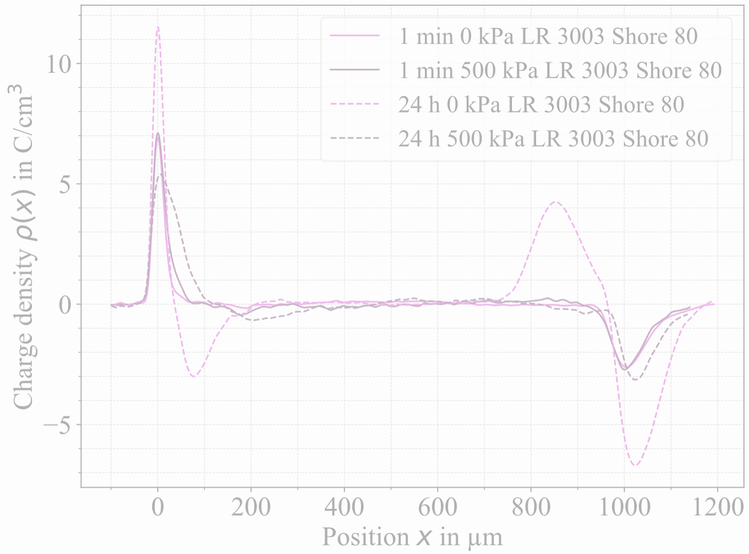


LR 3003 Shore A 30

- Suppression of deep charge trapping with high pressure
- Soft silicone is compressed and deformed – resulting in a measurable change in thickness of up to 50 µm

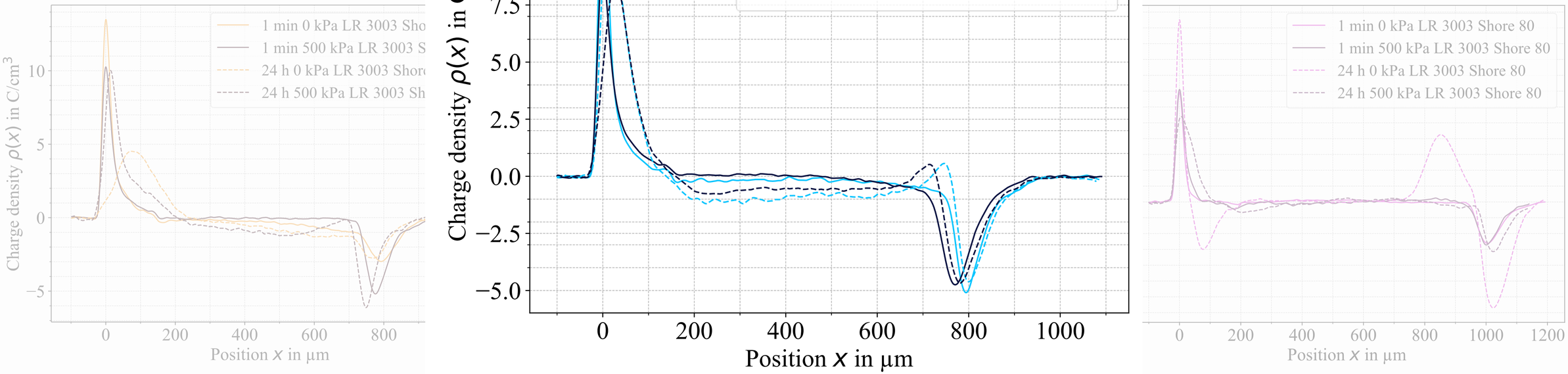






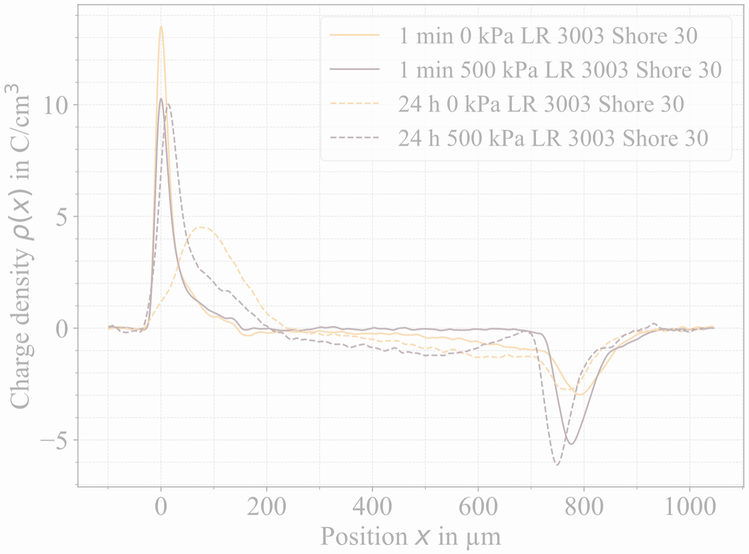
LR 3003 Shore A 60

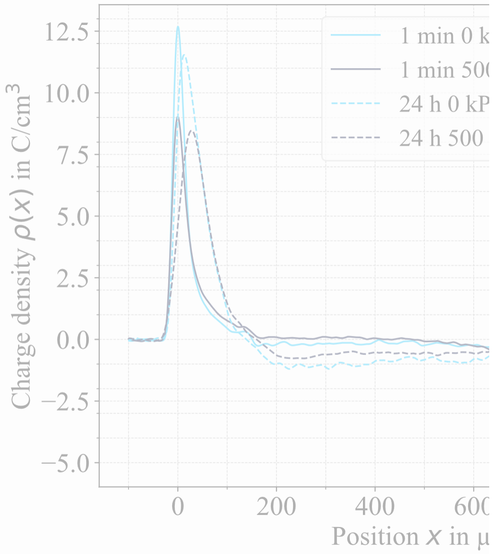
- Slight deformation under pressure– ca. 30 µm
- No effect on space charge formation – apparently no compression of the polymer matrix

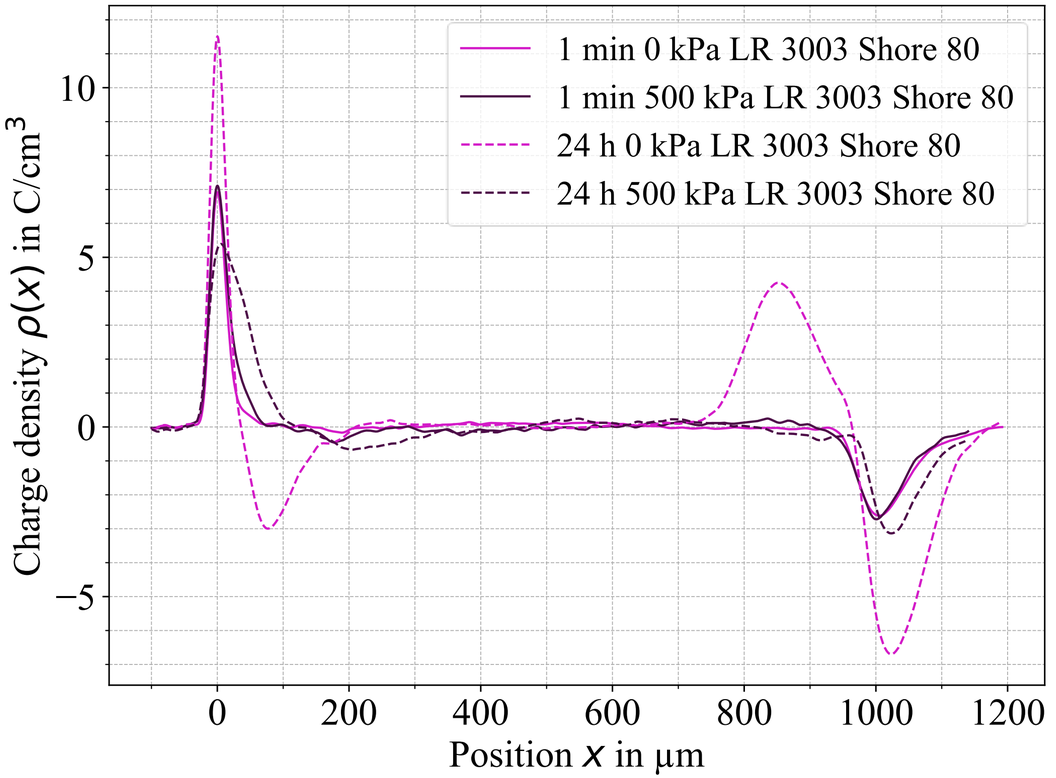


LR 3003 Shore A 80

- No deformation and therefore no change in thickness
- Space charge formation is nevertheless strongly suppressed by the contact pressure
- Changes to the surface caused by pressure
- Space charge emission inhibited

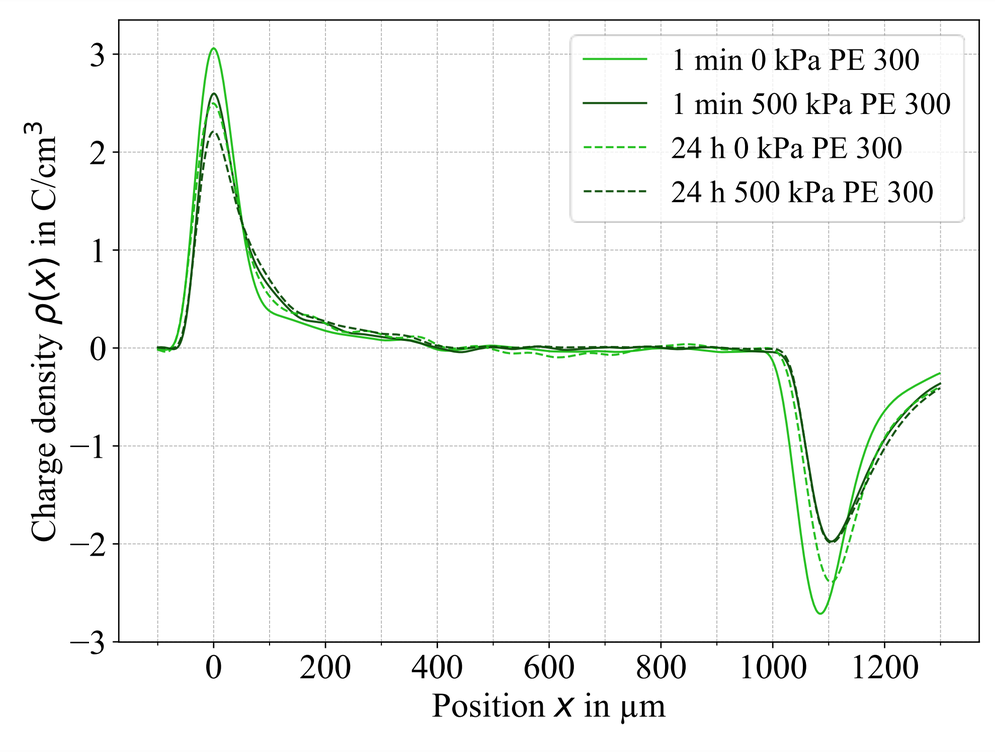






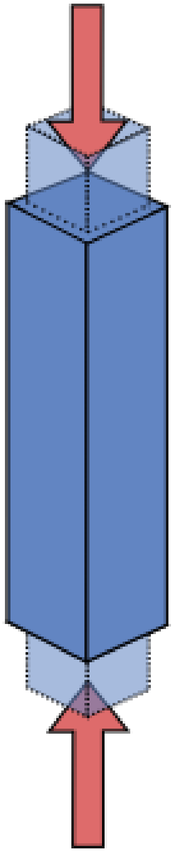
PE 300

- PE 300 as reference material
- No sensitivity to applied pressure
- No space charge accumulation at chosen field strength
- Minimal variation in interfacial charges – due to compression of the silicone oil



Theoretical background

- Silicone is considered nearly uncompressable
- no change in volume, only deformation → density remains constant
- *Under extremely high pressure: the polymer matrix is compressed*
  → This increases the Young's modulus
  → a slight increase in the speed of sound is possible
- In the case of 500 kPa – significant deformation for Shore A 30
- The thickness is reduced, thereby altering the space charge measurement



Summary and Outlook

Findings:

- In pressure ranges of elastic deformation, the acoustic properties remain unchanged
- Deformation causes the thickness of the test specimens to change
- Contact pressure has a significant influence on the formation of space charges

Questions arised:

- To what extent does the silicone oil (coupling medium) contribute to the formation of the measured heterocharges?

Next Steps:

- Measurement of Conductivity with and without pressure
- Further Comparisons– LIPP/PEA as well as LIPP/LIPP (Berlin/Zittau)

Thank you for your interest!

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