Micro and Nanoparticles in Functional Materials

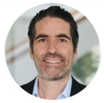
Trends in Micro Nano

Prof. Dr. Jens Ulmer

IMP | Institute for Microtechnology and Photonics

OST Ostschweizer Fachhochschule

OST – Universities of applied sciences



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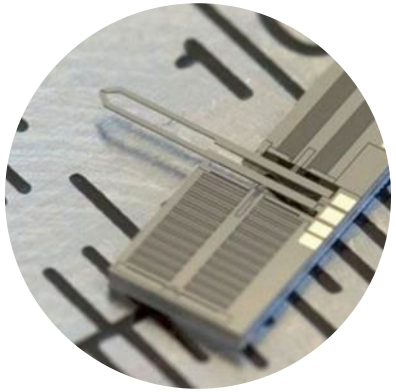
Institute for Microtechnology and Photonics (IMP)



Microtechnology

MEMS design and fabrication

Packaging

Printing & Pattern Technologies

Cleanroom

Infrastructure (620 m^2 ISO 5-7)

Complete 8’’ Processing

Pilot series

Photonics

Optics

Waveguides

Machine Vision

Laser-Processing

Production Metrology

Certified coordinate measurements

Micro- and nano-topography

Materials

Surface functionalization

Polymer formulation

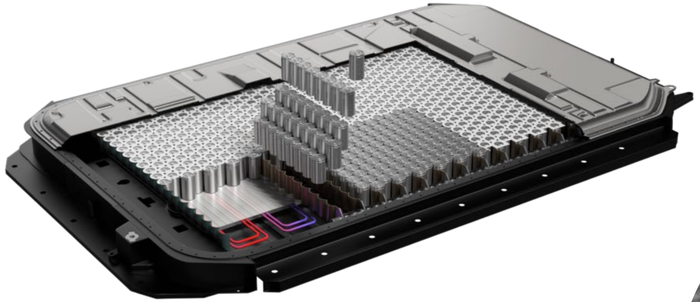
Materials testing

Surface analysis

Overview where particles add functionality

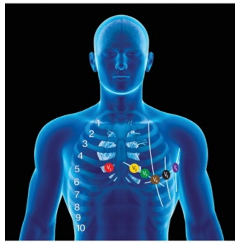
Thermal conductive adhesive

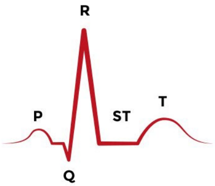
enabeling cell to pack design in BEV



Electroconductive Polymer

enabeling longterm vital sign monitoring





Challenges

- Viscosity
- Sedimentation
- Interfacial adhesion

Critical parameters

- Matrix – particle interaction

→ tuning particle surface by functionalization

- Particle size

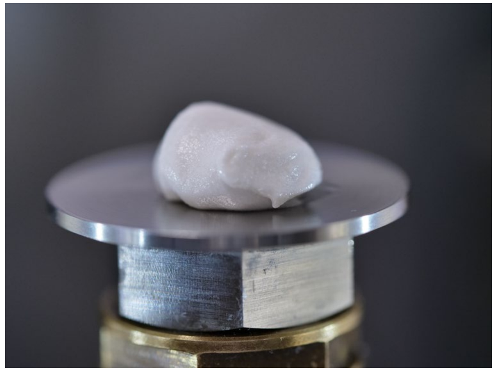
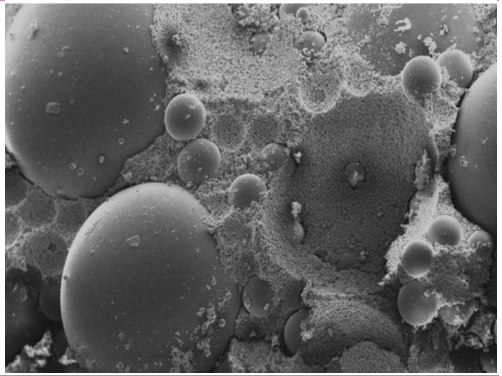
→ adjusting and controlling size distribution by wet milling

- Particle materials

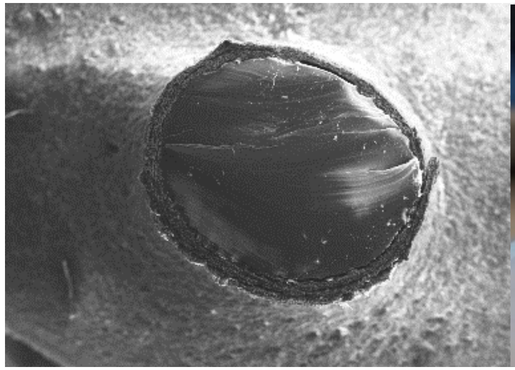
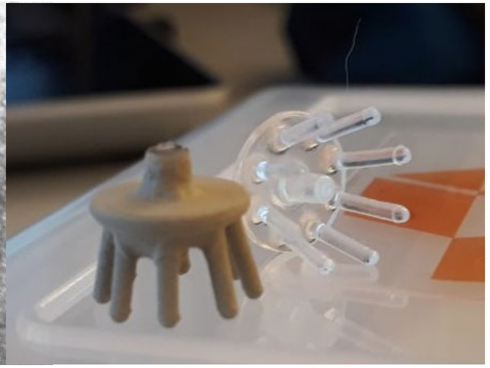
→ combining different materials to improve properites

Overview where particles add functionality

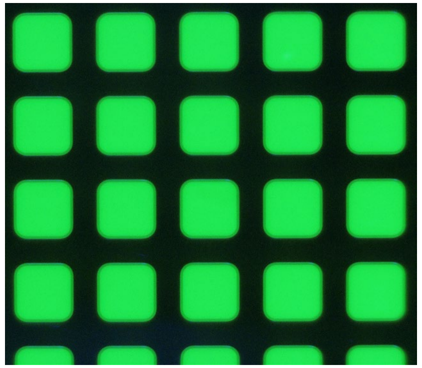
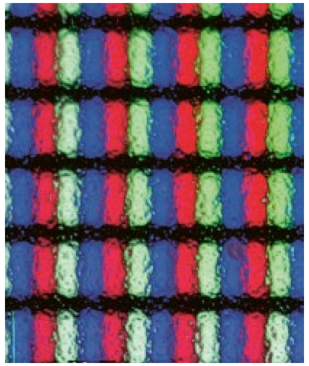
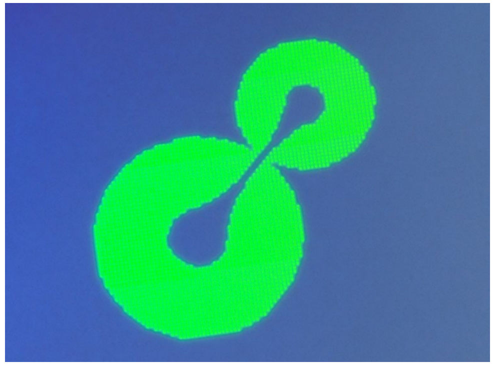
Thermal conductive adhesive

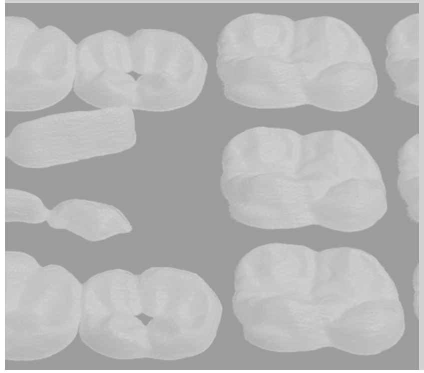
Highly filled, conductive TPU for medical application

Jetting of particle dispersions

Printing slurries for dental appliation




45267.1-IP-EE: 2K-Gapfiller

Problem:

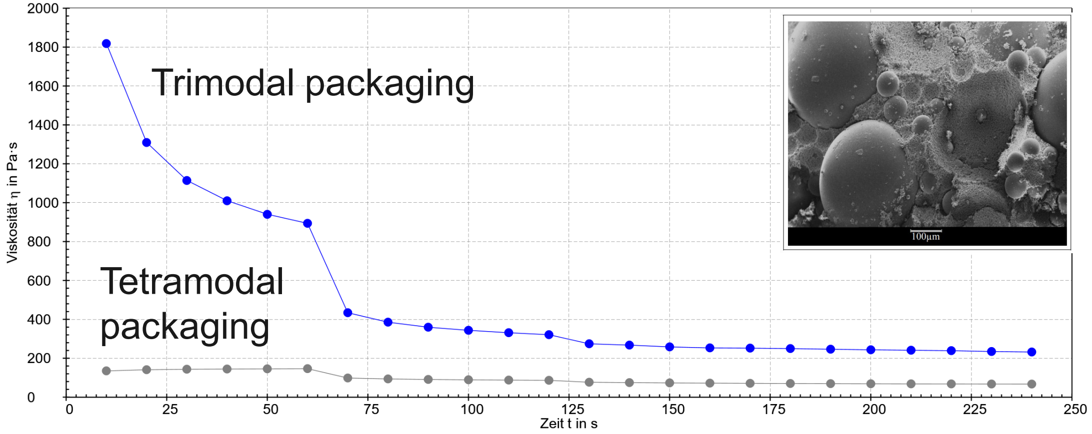
- Highly filled polymer systems tend to have high viscosity

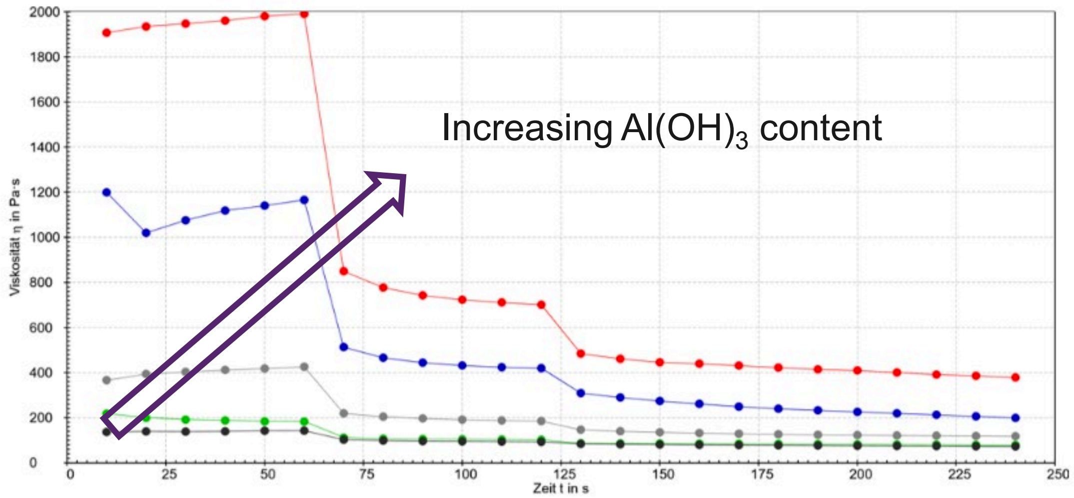
Solution:

- Optimize particle packaging to increase thermal conductivity
- Adjust surface energy to polymer matrix

Properties:

- Viscosity optimized gap filler
- Therma conductivity of 3 W/mK





32618.1-IP-ENG: Long term skin electrodes - Dryodes

Problem:

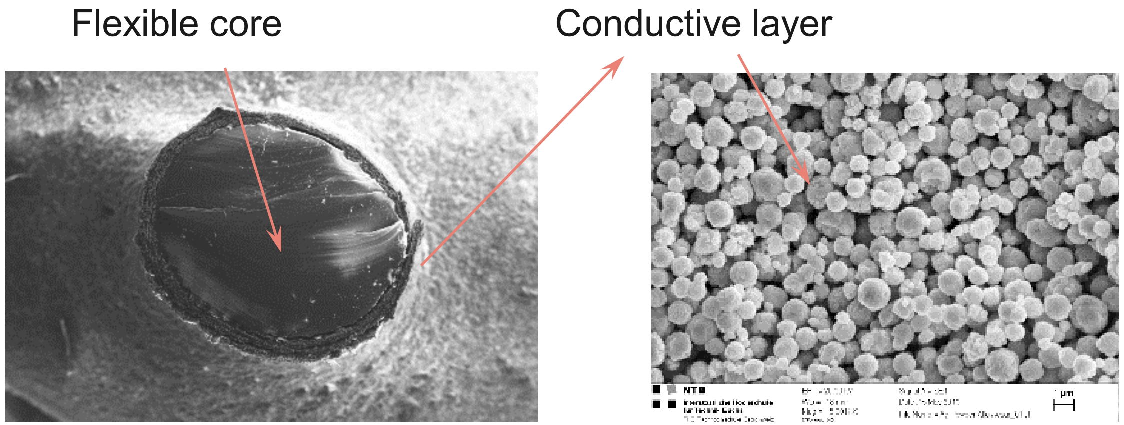
- Highly filled polymers have low tensile strength

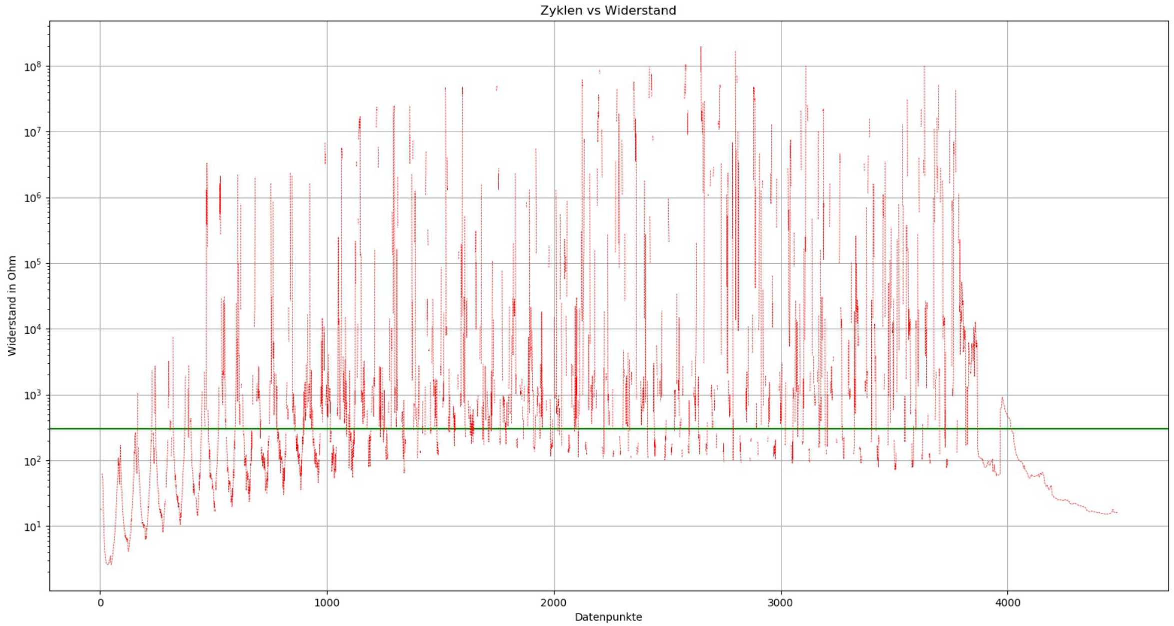
Solution:

- Flexible core: TPU
- Conductive layer: Ag Powder/Flakes in TPU

Properties:

- High conductivity at „high“ tensile strain (20%)
- Conductivity recovers after high strain
- Mechanical properties similar to base TPU





Avantama

Problem:

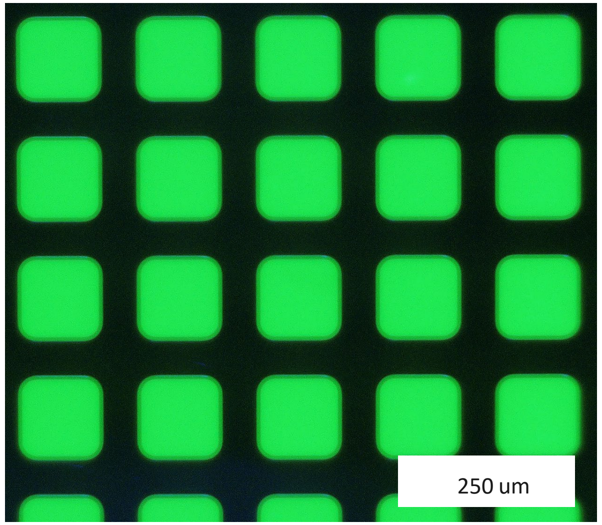
- Jetting of highly filled suspensions

Solution:

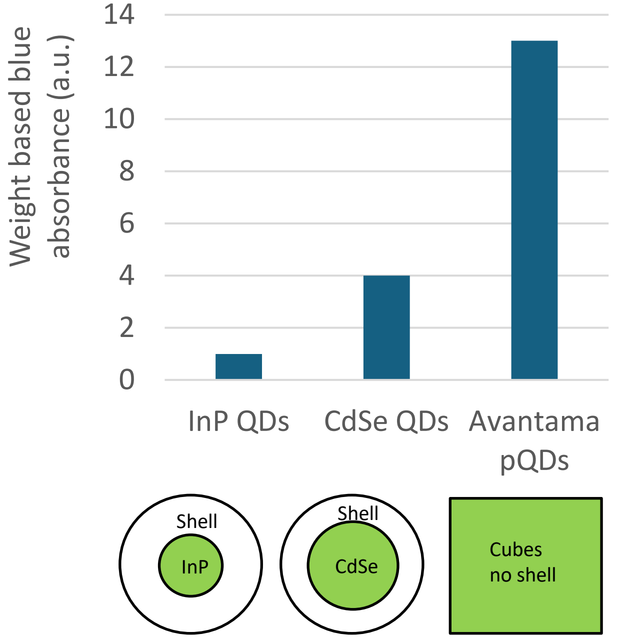
- Adapting particle size and surface tension
- Modifing matrix chemistry
- Ballancing rheological additives

Properties:

- Jetting supension with 30 wt% filling

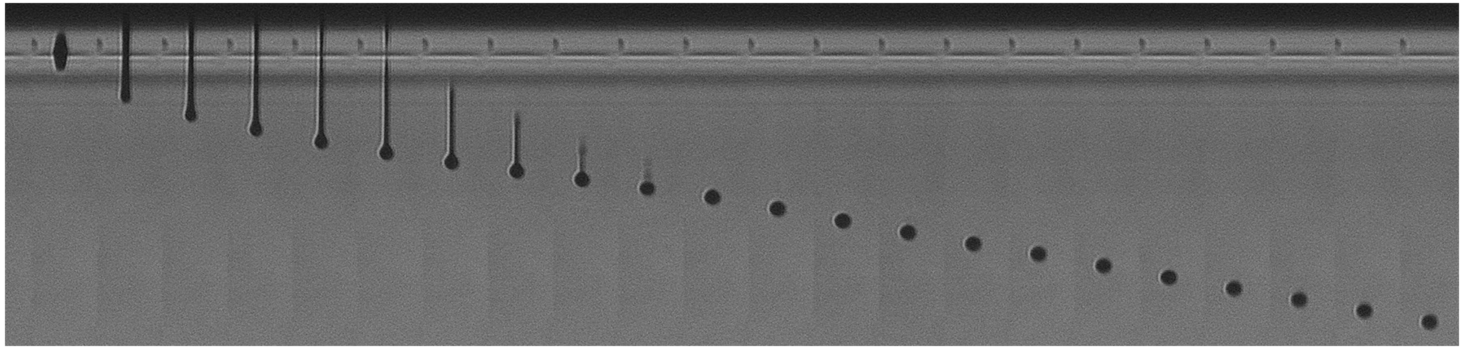


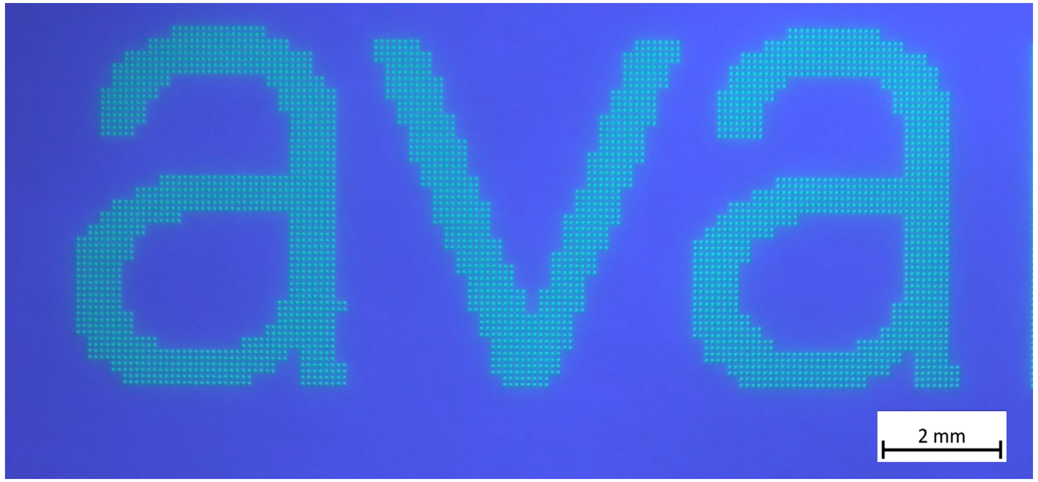
Green pQD ink-jet ink printed into black banks (130µm pixel size)

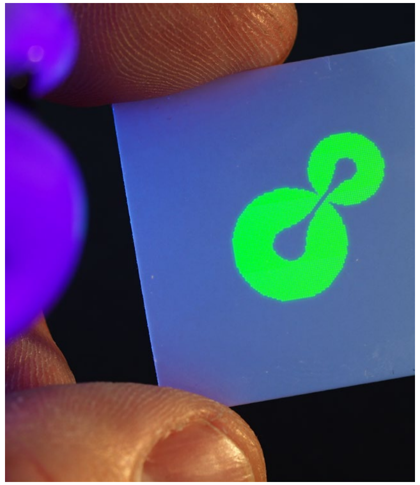


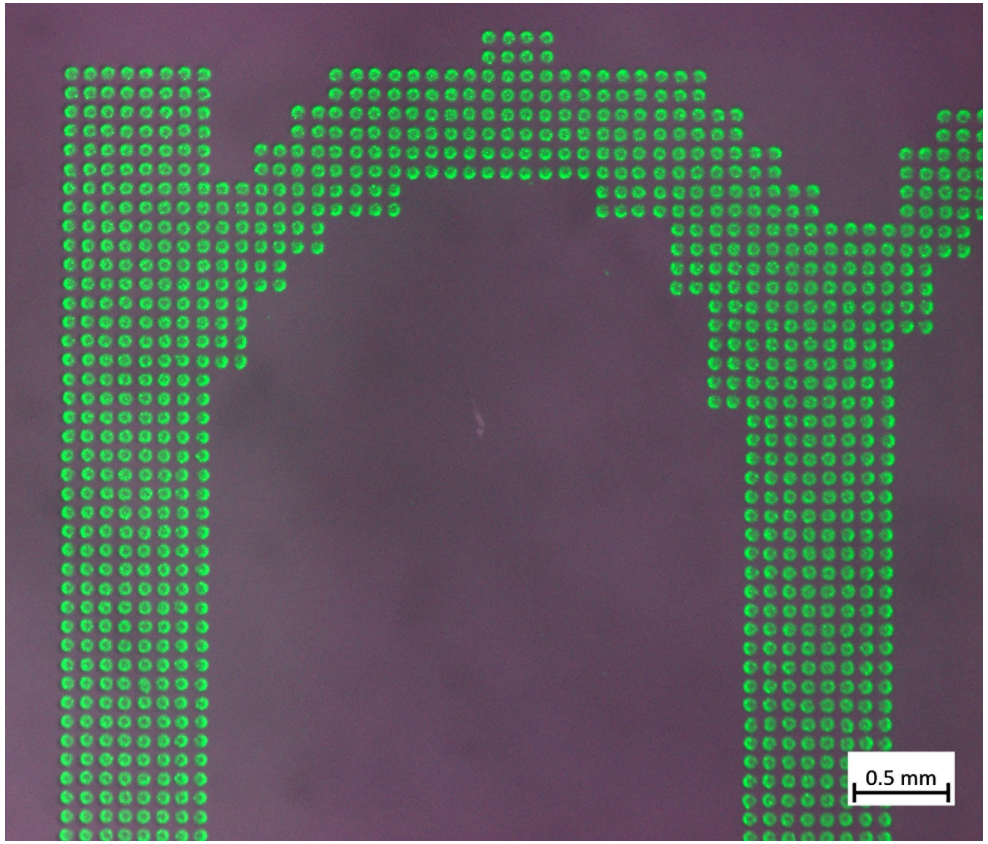
avantama®

Jetting & Printing of pQD-Inks





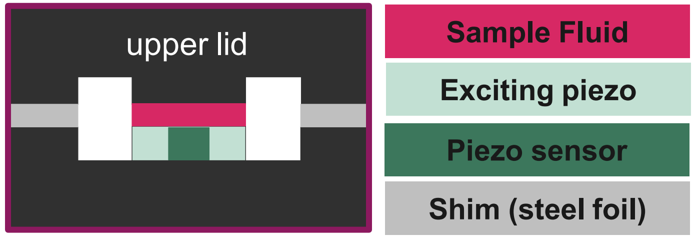


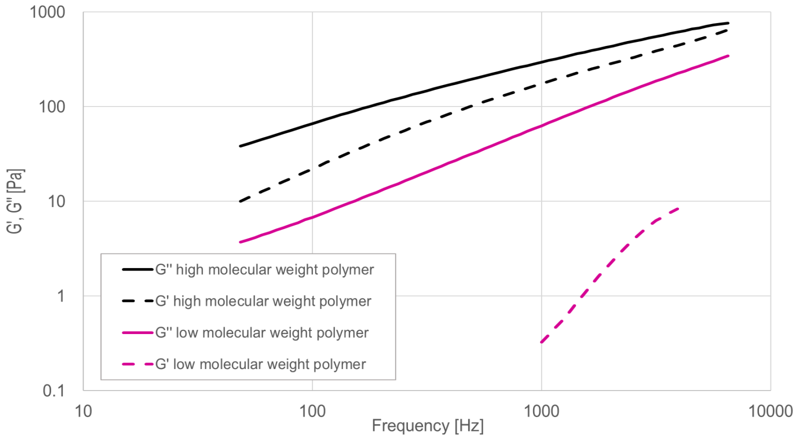


Printed demonstrator exhibited at world's leading display show (SID Display Week '24)

Rheological Characterisation Techniques at IMP

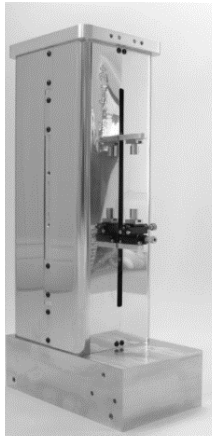
TriPAV (High Frequency Rheometer)

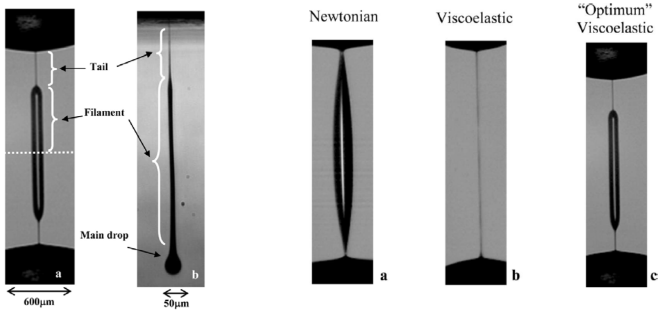


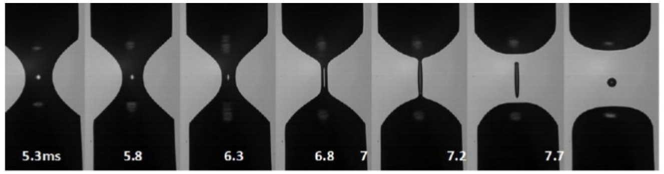


- Complex rheology analysis (oscillatory, sinus signal): Studying jet-ability of inks
- TriPAV printhead mode - standard square waveform: Characterisation of ink damping behaviour

TriMaster (Filament Stretch Rheometer)







- TriMaster is a capillary breakup extensional rheometer to measure the extensional and filament stretching behaviour of complex fluids – colloids, polymer solutions, paints inks, food, consumer products and melts.
- The Trimaster investigate the elongation properties of viscoelastic fluids by stretching a small amount of fluid attached between two identical pistons.