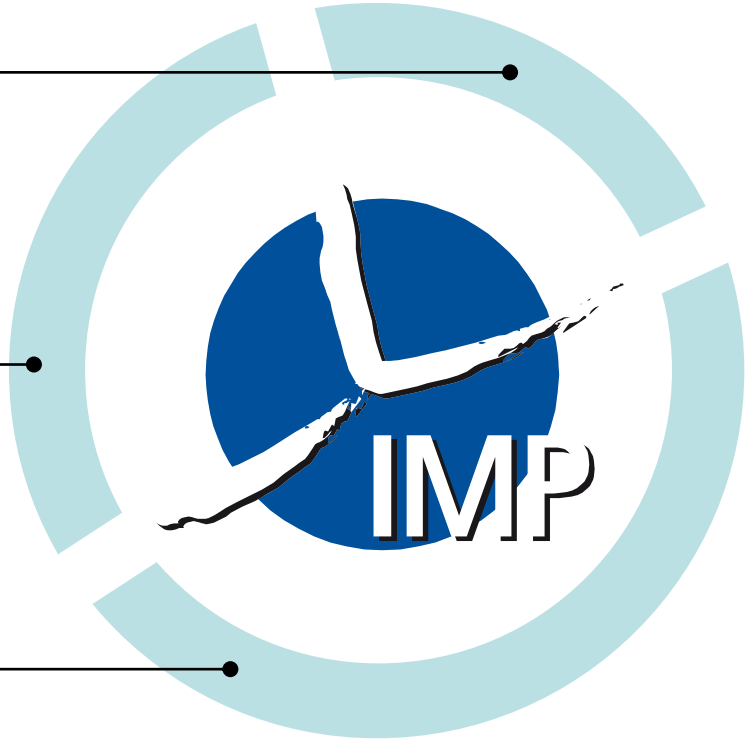
Leibniz Universität Hannover

Institute for Multiphase Processes
Center for Biomedical Engineering
Prof. Dr.-Ing. Birgit Glasmacher

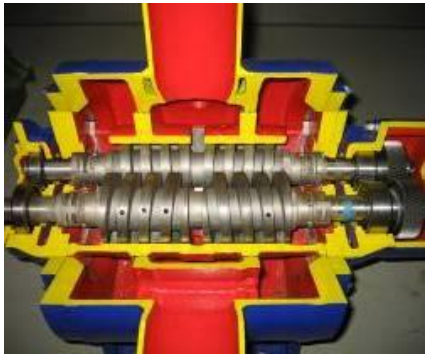
Multiphase Flow

Visualisation and Simulation

Process Engineering in Medicine



Multiphase Flow – Pump Technology



Strömungsrichtung →

- Gas
- Wasser

Blasenströmung

Kolbenströmung

Schichtenströmung

Wellenströmung

Schwallströmung

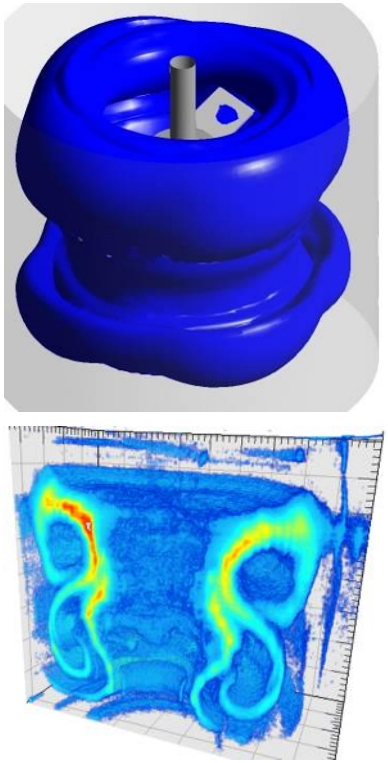
Pfropfenströmung

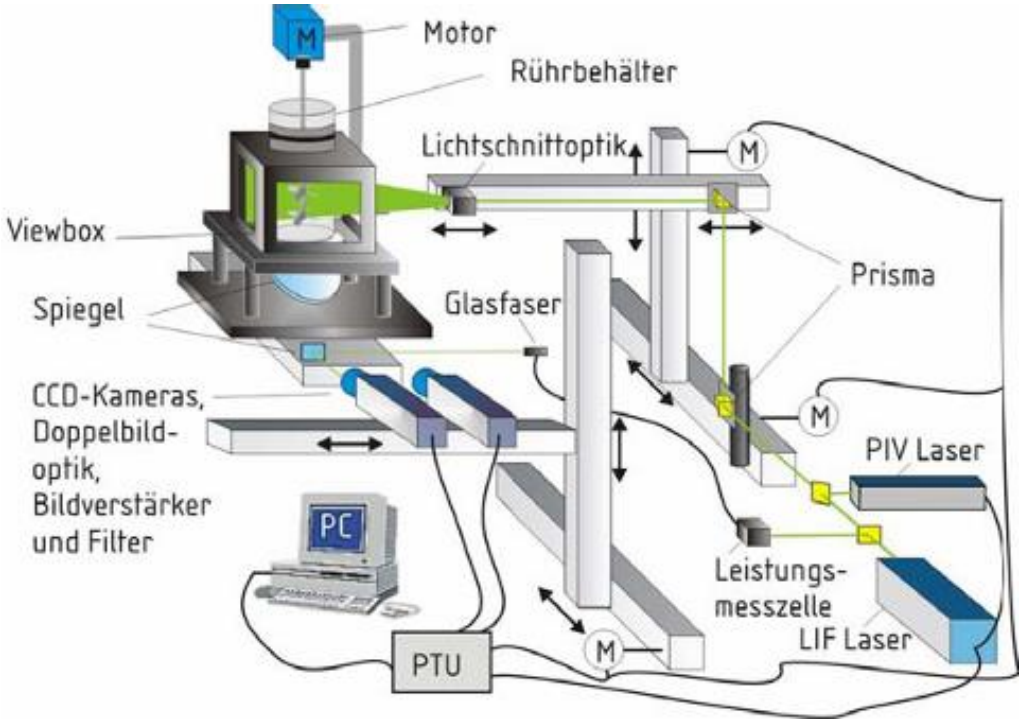
Filmströmung

Nebelströmung

e.g. Pumping of multphase flow mixtures (oil,water,gas) but also blood and cell containing solutions

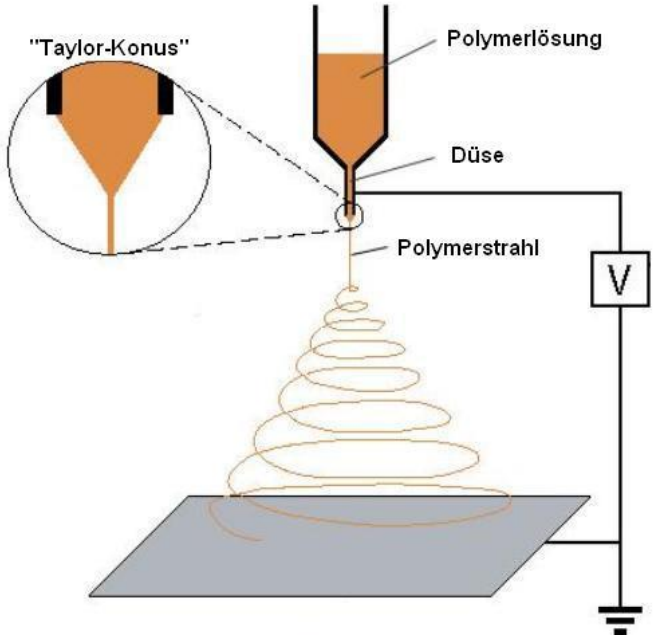
Visualisation and Simulation – Heat and Mass Transport Processes

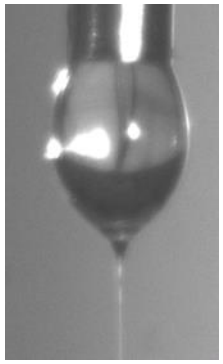


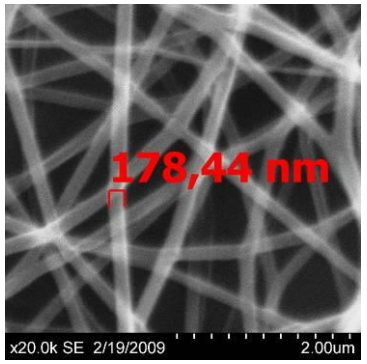


e.g. Description of mixing processes in roting cylinders, of cooling and drying processes (lyophilisation) by PIV, LIF

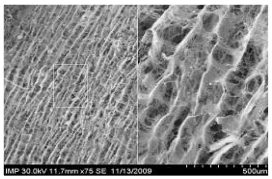
Polymer Technologiy– Membranes and Matrix Structures for Regenerative Medicine

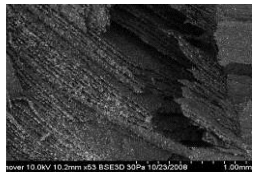


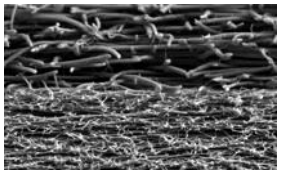


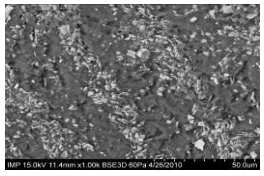


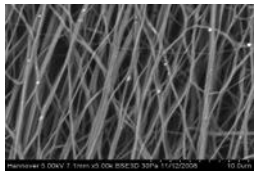
e.g. Matrices for heart valves, nerve conduits, vascular grafts, stents



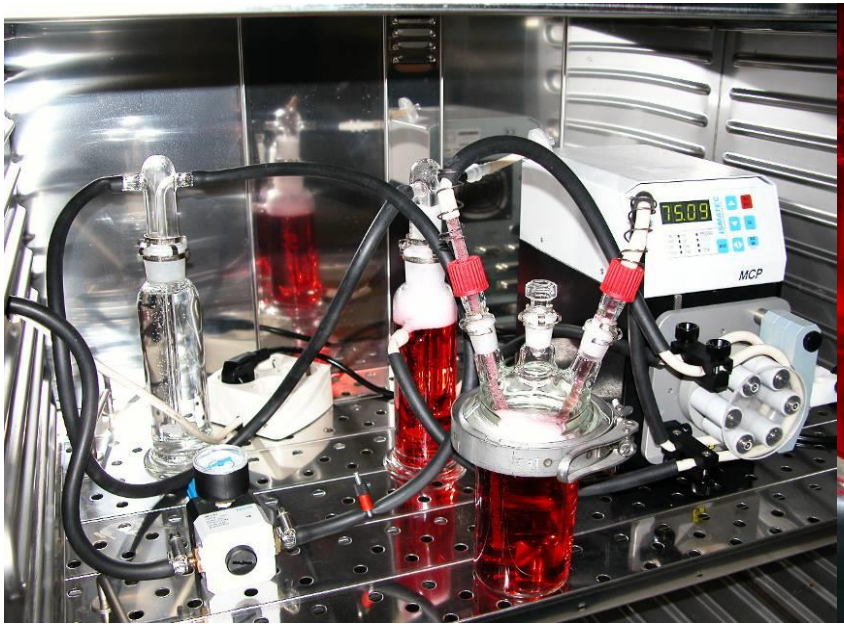




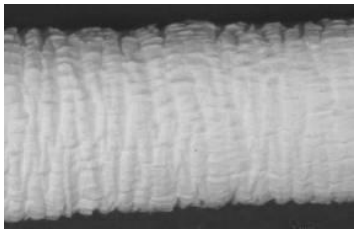


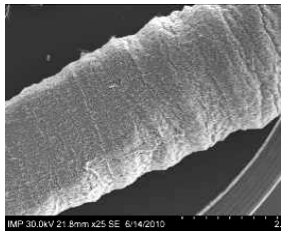


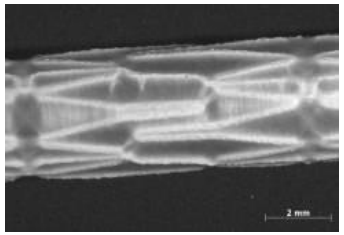
Functional Tissue Engineering – Production of Tissue



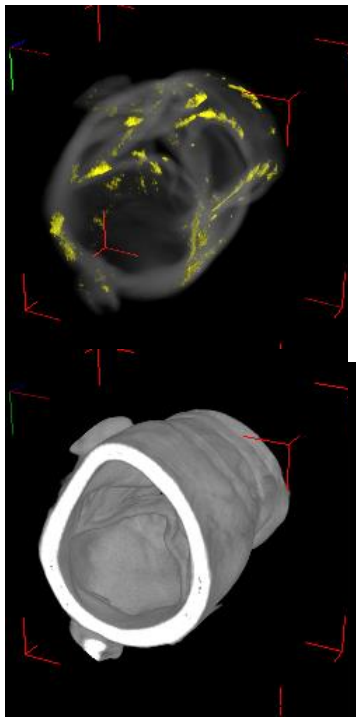
e.g. Cultivation of cells and tissues in bioreactors (here: heart valve)

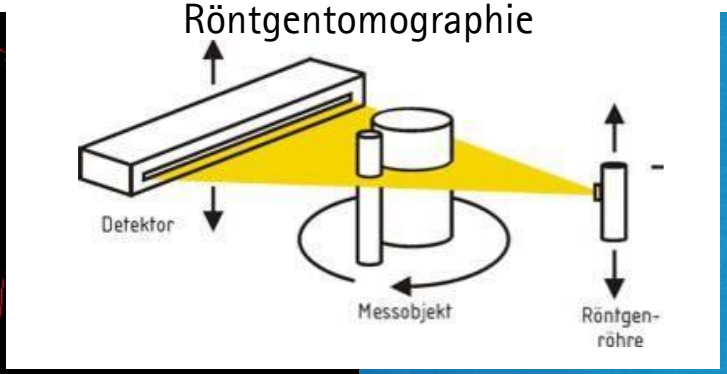


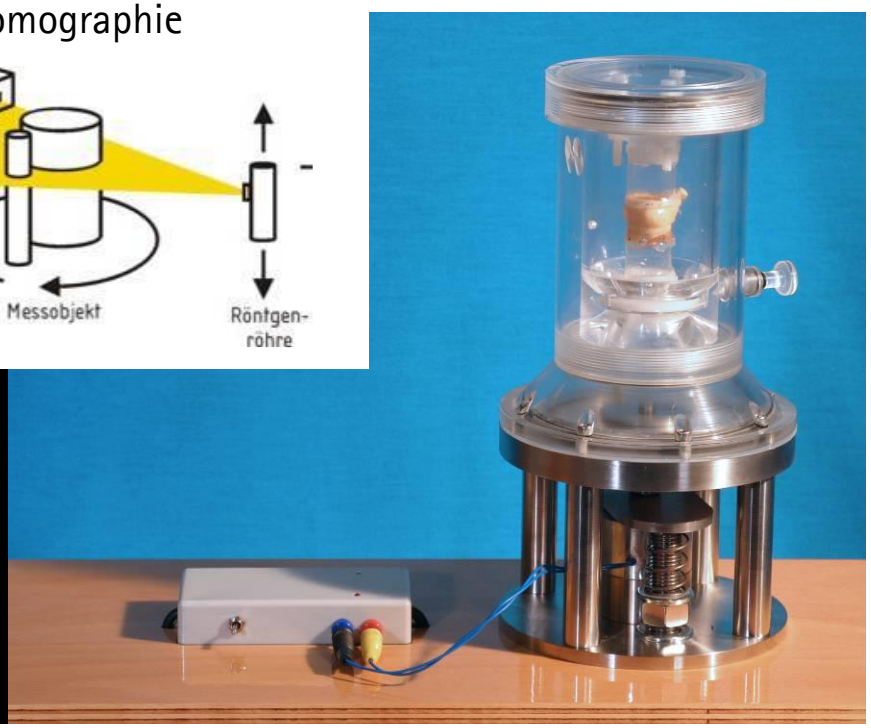


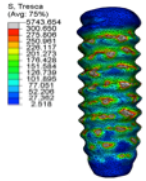


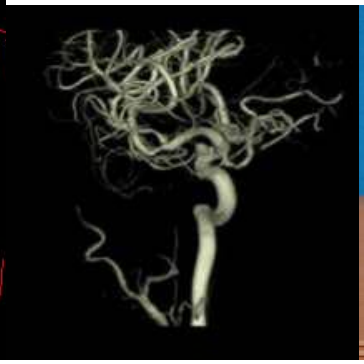
Biomaterials – Testing, Visualisation and Characterisation



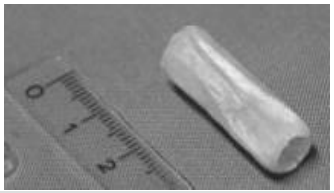


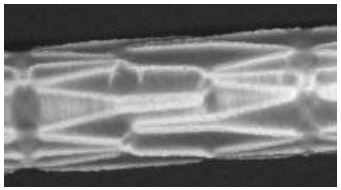




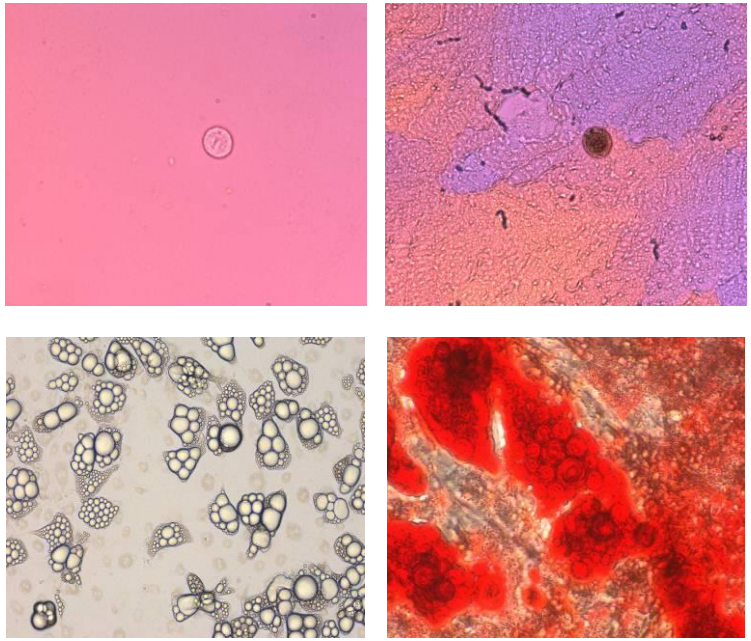


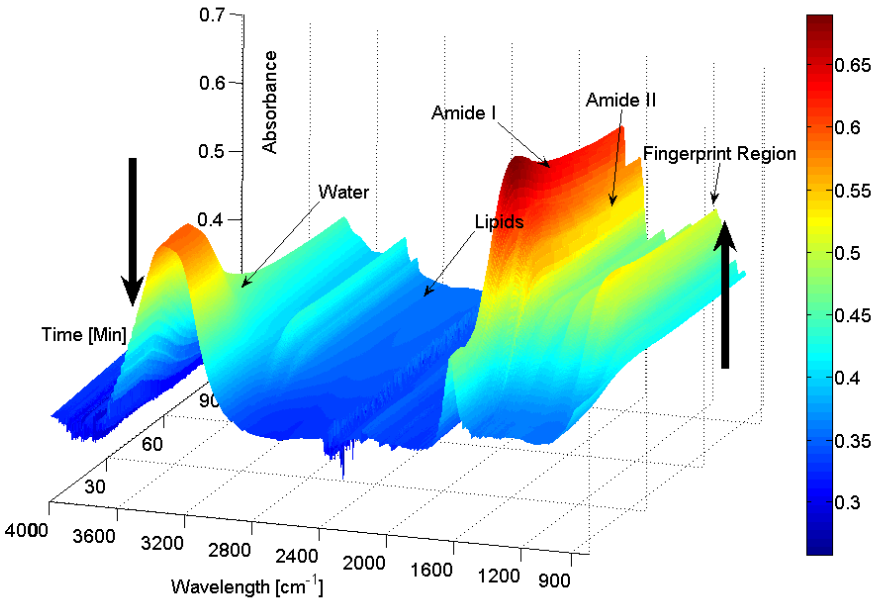
e.g. Visualisation, Characterisation, Simulation, Testing of Tissue,
Set-up of a testing laboratory for hemocompatibility



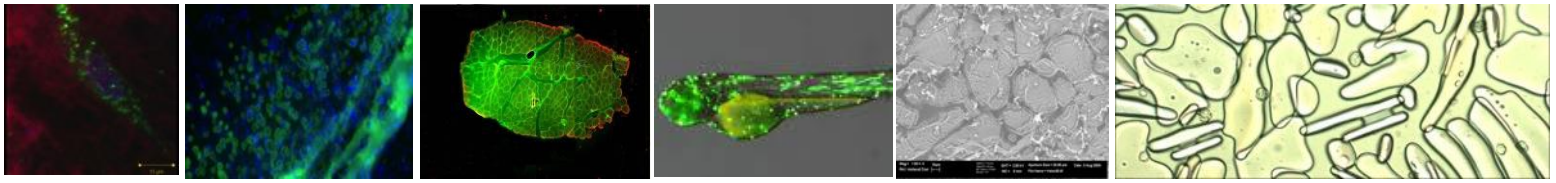


Cryotechnology – Storage Technologies for Living Cells I Tissues I Organs

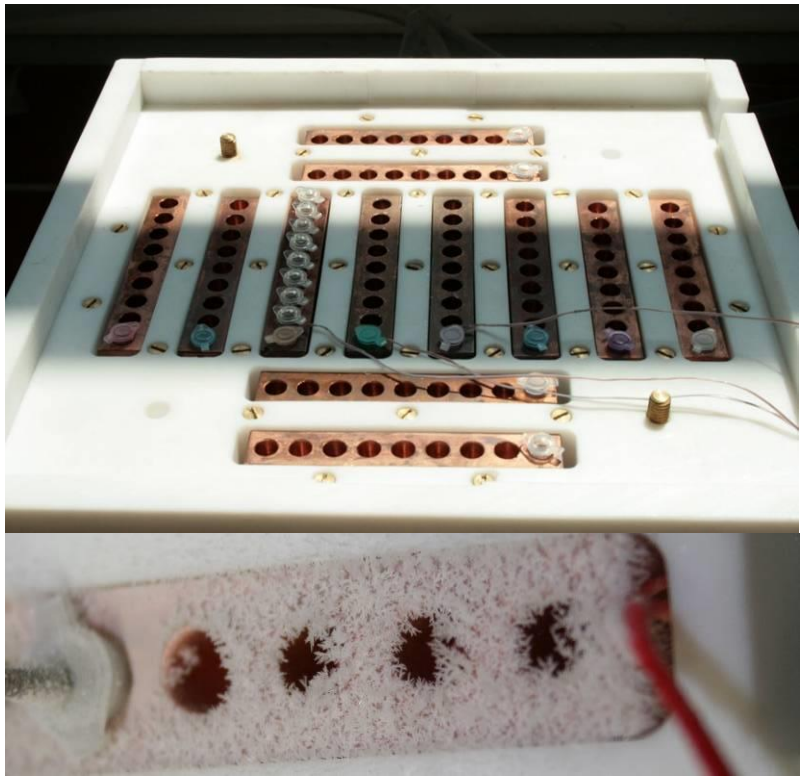


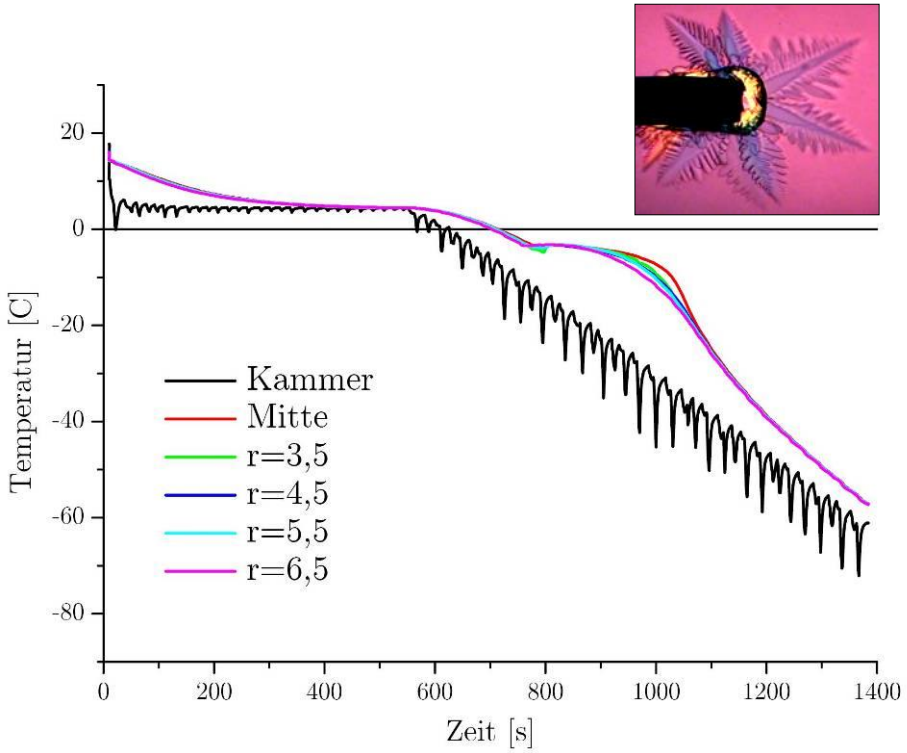


e.g. Influence of freezing processes on protein structure, lyophilisation, controlled nucleation



Cryotechnology – Development of Freezing Processes and Devices





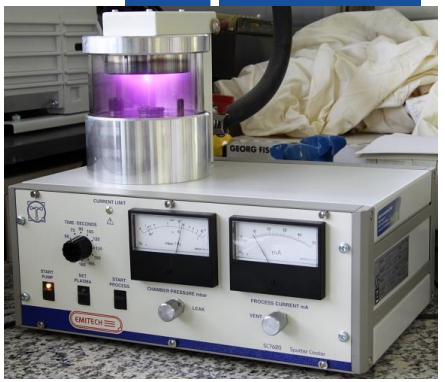
e.g. Development and Optimisation of a µ-Freezer and automated nucleation

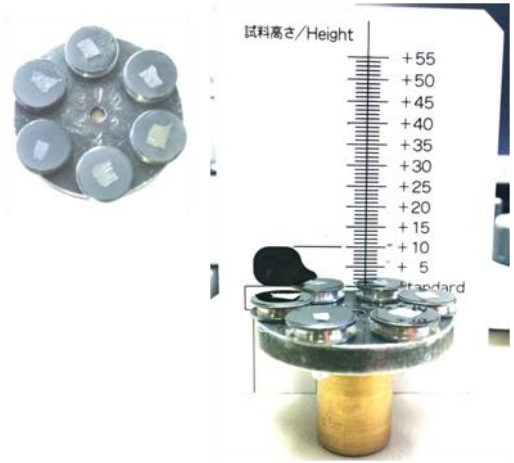
Rasterelektronenmikroskopie

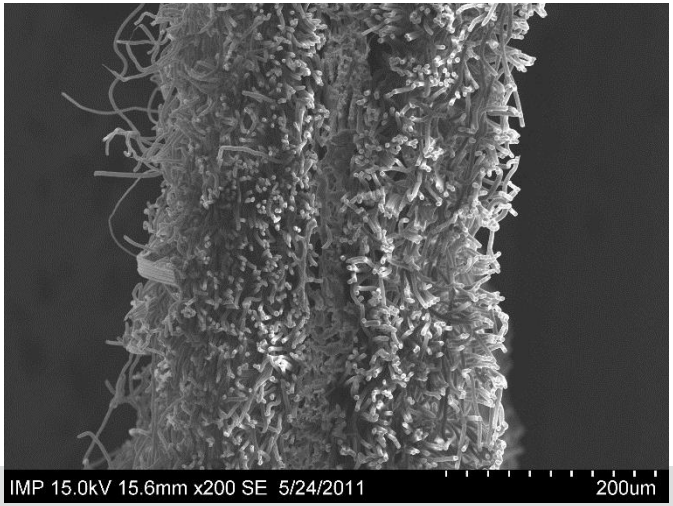
Hitachi S-3400

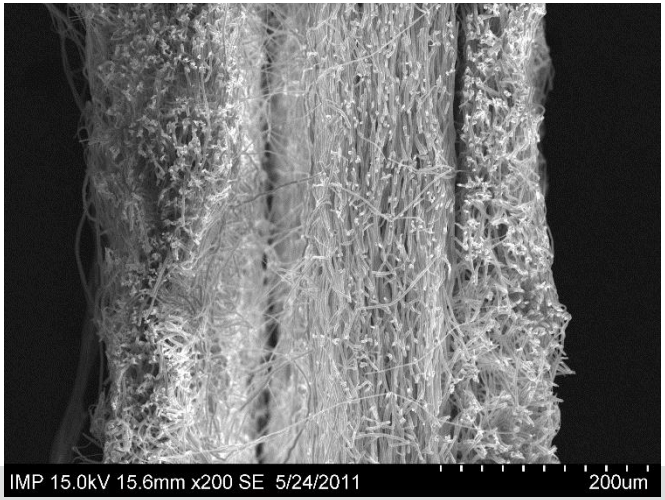
Rasterelektronenmikroskop
- Vergrößerung: 50x-10000x
- Auflösung: 5MP(2560x1920)
- Hochvakuum
- Spannung: 10-20 kV

-Verwendung von biologischen Proben schwierig







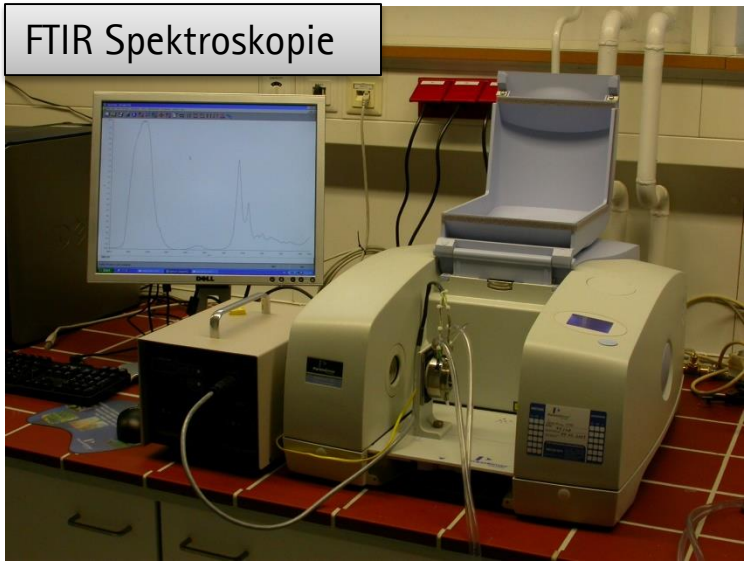


Weitere Methoden

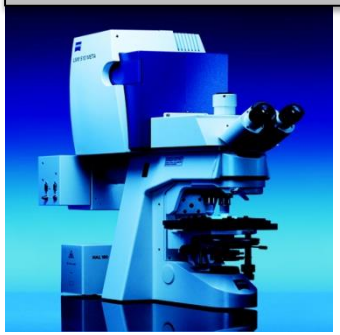
- Physikalische Prüfungen
- Chemische Prüfungen
- Optische Prüfungen

UV/Visible Spektrometer

FTIR Spektroskopie



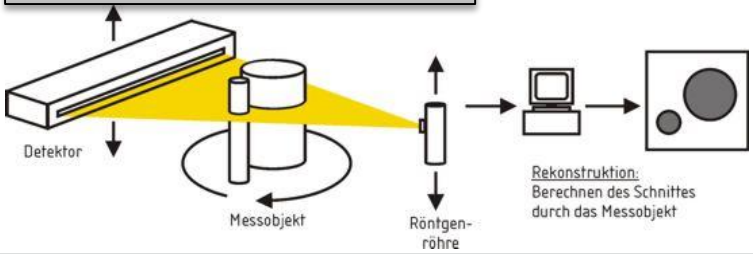
Konfokales Laser Scanning Mikroskop



Fluoreszensspektrometer

DSC

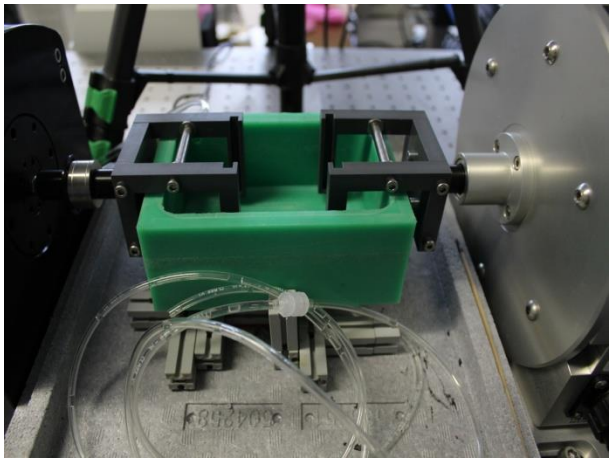
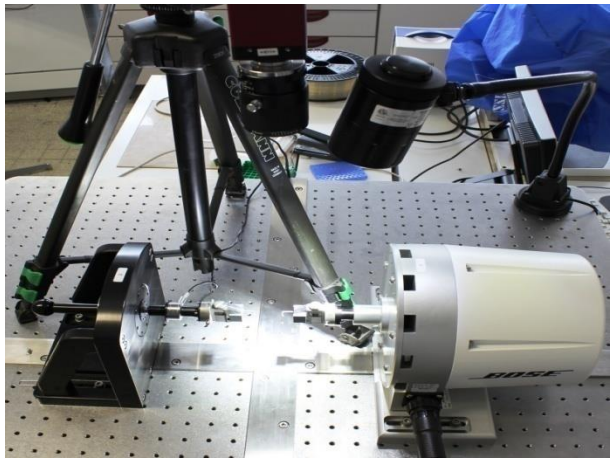
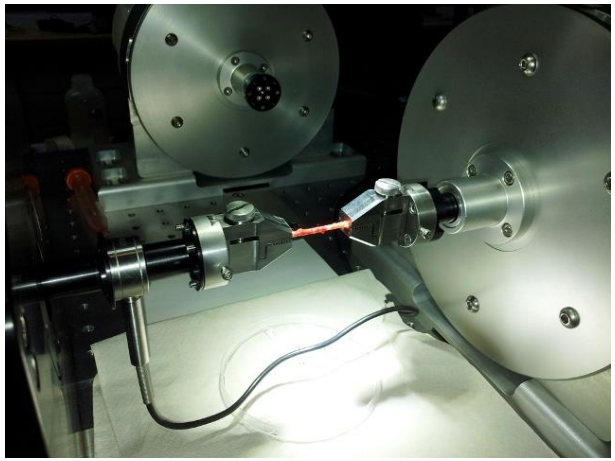
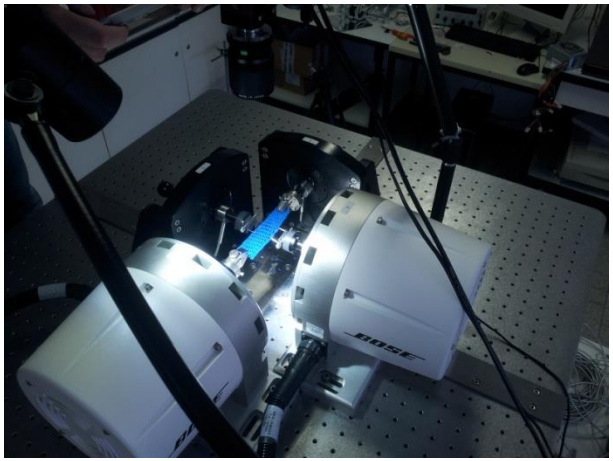
Computertomograph (CT)

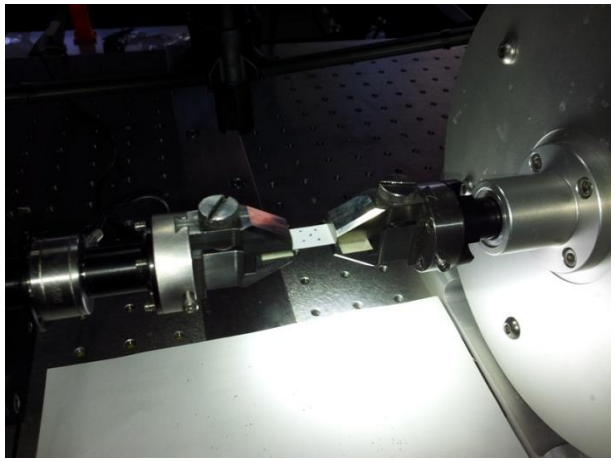


Mechanische Prüfung

- Statistische Untersuchung
- Dynamische Untersuchung
- Spannung: 0-200 N/m^2
- Dehnung: -6,5 mm bis +6,5 mm

- Mechanische Prüfung in verschiedenen Medien
- Uni-axial / Bi-axial
- Polymere/ Metall/ Keramik/ Biologische Gewebe
- Ermüdungstest



+eigene Protokolle möglich

-aufwändige Auswertung

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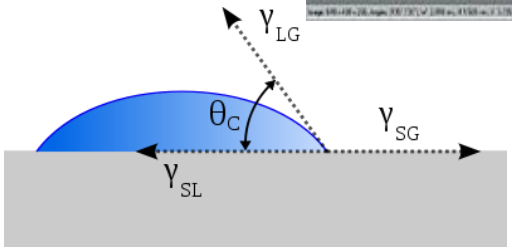
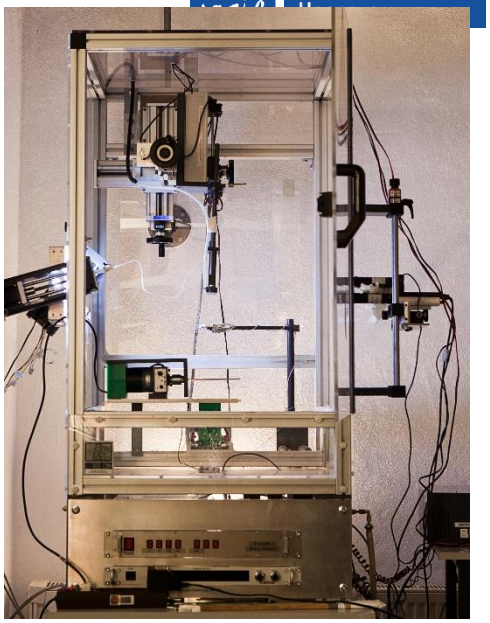
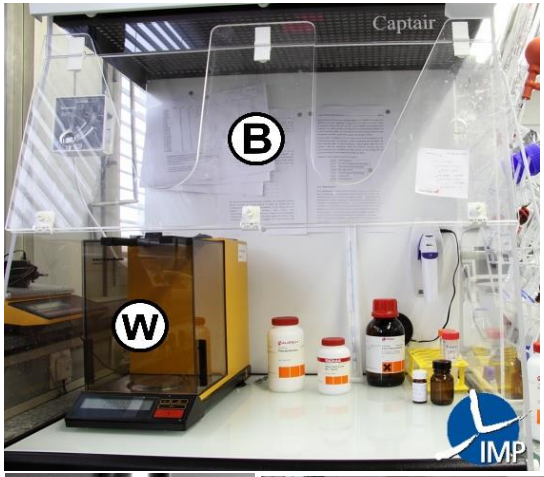
Kontaktwinkel-Messgerät

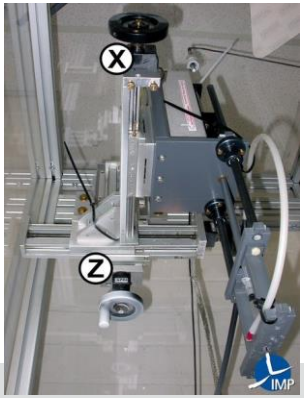
- manuelles oder halbautomatisches Kontaktwinkelmessgerät mit niedriger Investitionsschwelle.
- hochauflösende IEEE-1394-Kamera mit 79 fps bei Vollauflösung
- Messbereich
  - Kontaktwinkel: 1-180°
  - Oberflächenspannung: 0,01 bis 1000 mN/m
- Messwertauflösung
  - Kontaktwinkel: 0,1°
  - Oberflächenspannung: 0,01 mN/m
- Oberflächencharakterisierung für die Zelladhäsion auf Substrat, Film oder Scaffold

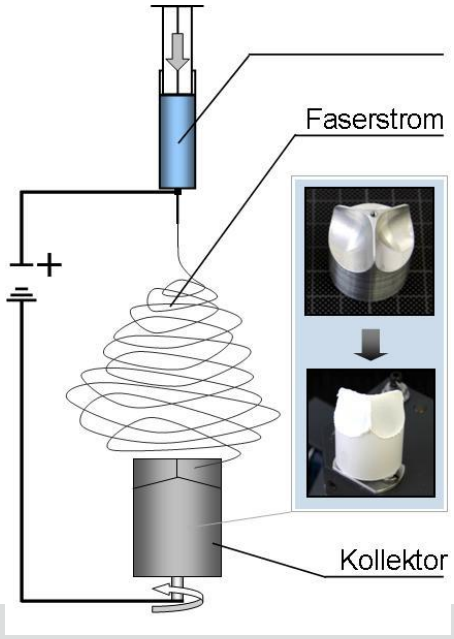


Elektrospinning







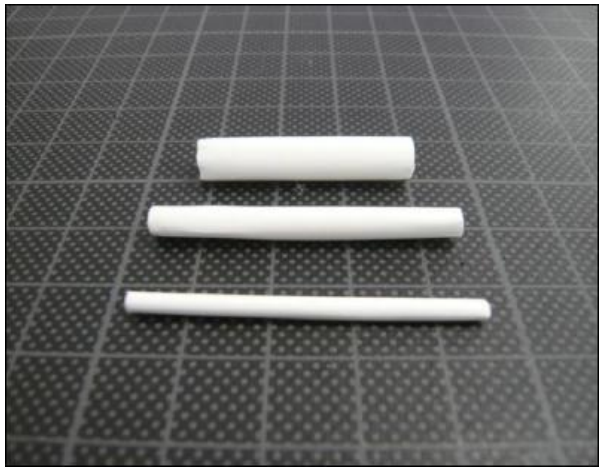


Elektrospinning von Fasern

- Faserdurchmesser: 100 nm-10 µm
- Porengröße: 500 nm-20 µm
- Porösität: 60-90%
- Spannung: 5-30 kV
- Flussrate: 0,1-10 ml/h
- Abstand: 10-40 cm

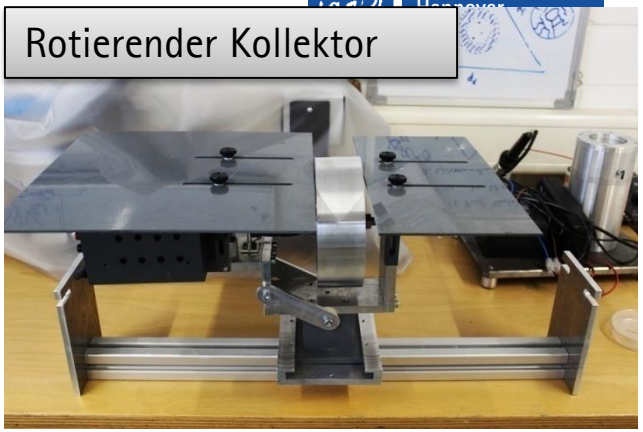
+einfacher, flexibler Prozess
-Sterilität

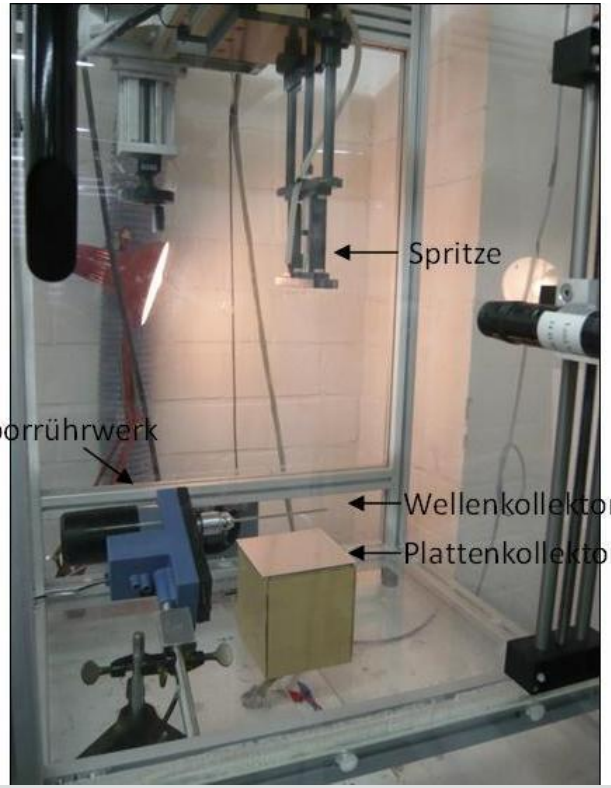
Elektrospinning

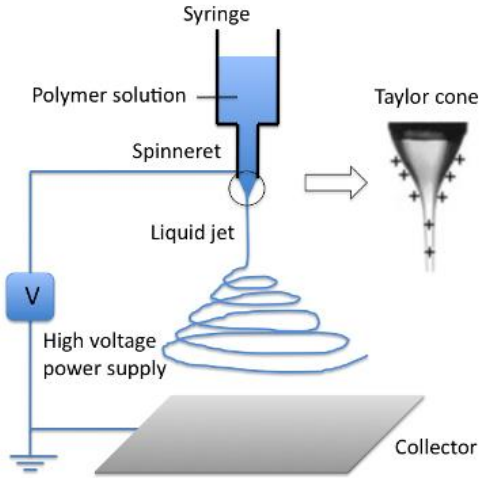


Basis Kollektor

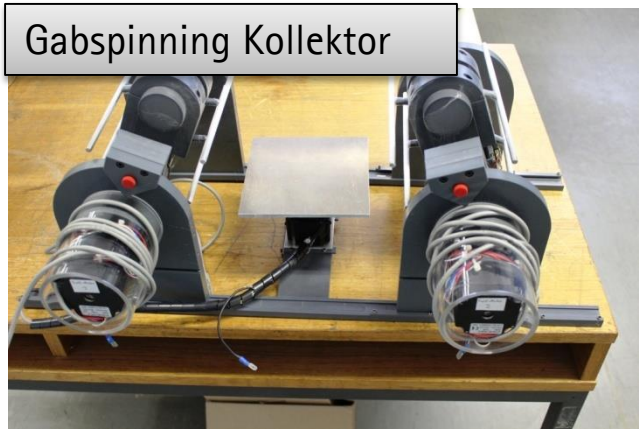
Rotierender Kollektor



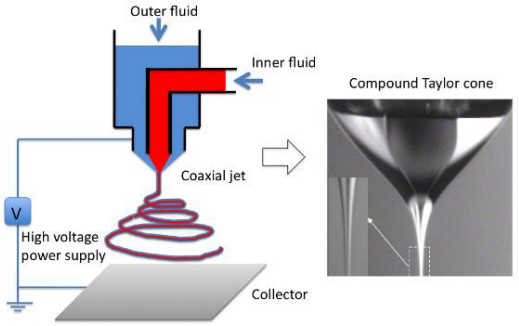




Gabspinning Kollektor



- Fasermatten
- Tubuläre Scaffolds
- Herzklappenscaffolds



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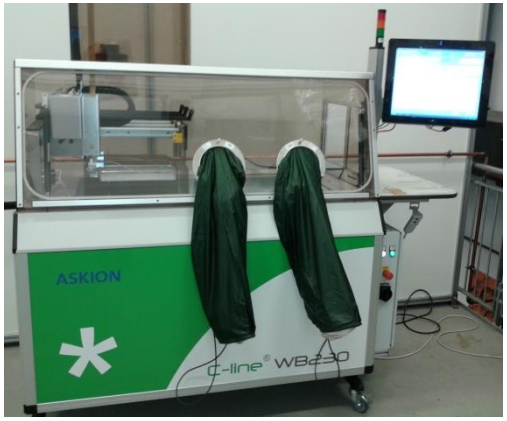
Air Products/Carburos Metallicos – CM 2000

Temperature range:	+35° C to -150° C
Cooling rate:	0.1 to 50 K/min
Chambers:	1
Functional principle:	- controlled with chamber temperature - Nitrogen injection and ventilation

Askion WB230 – C-Line



Temperature range:	+15° C to -160° C
Cooling rate:	0.1 to 50 K/min
Chambers:	3
Functional principle:	- controlled with chamber temperature - Nitrogen gas phase with/without sample temperature/seeding

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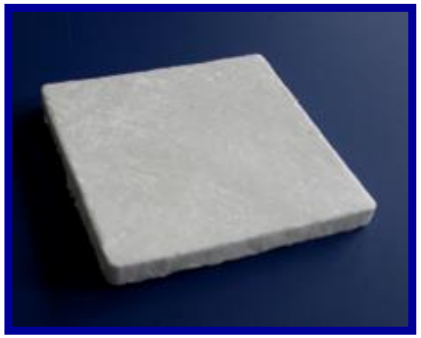
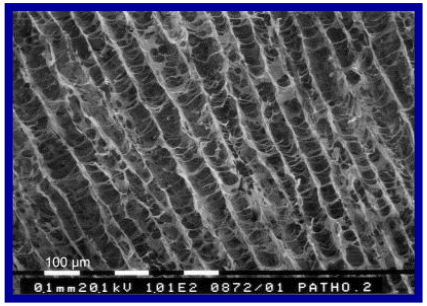
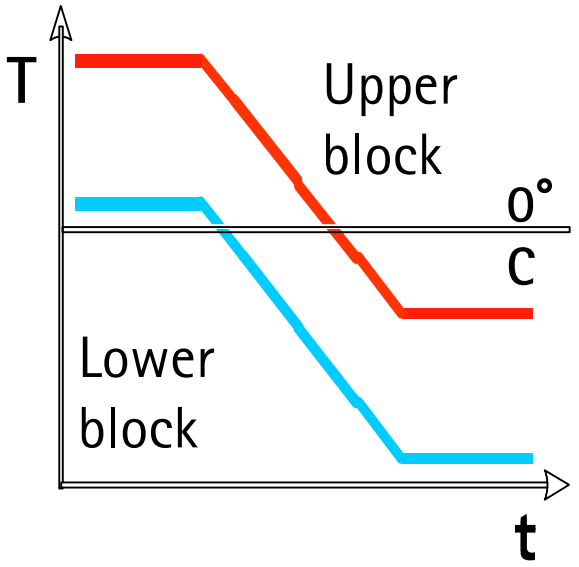
Power down system

Temperature range:	+35° C to -80° C
Cooling rate:	0.1 to 15 K/min
Chambers:	1
Functional principle:	controlled crystal growth with temperature gradient

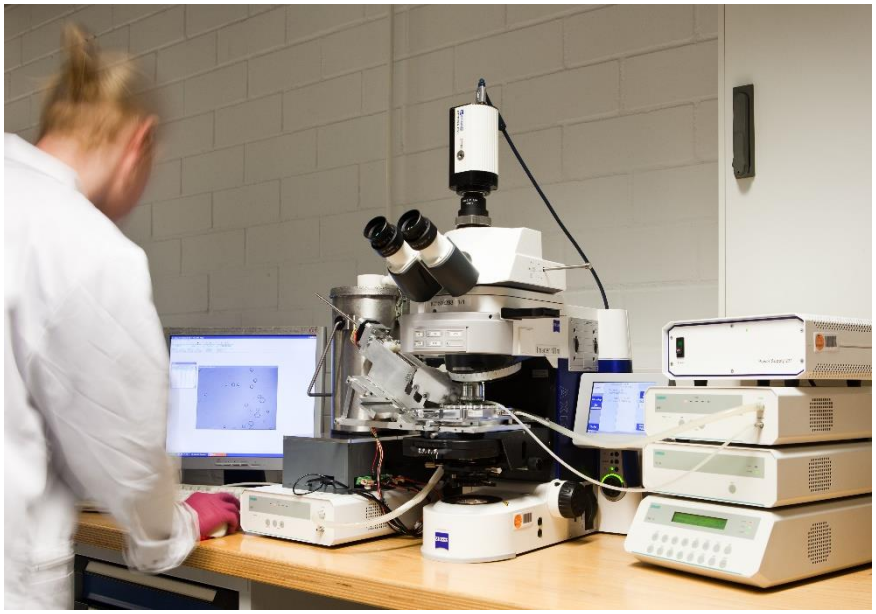
-size of test specimen limited







Kryomikroskopie und Gefriertrocknung



- Visuelle Untersuchung von Proben bis -196 °C
- Echtzeit Videoaufzeichnung

Gefriertrocknung

- Probenbehandlung
- Probenkonservierung

Feinmechanikwerkstatt

- Fertigung von Einzelteilen und komplexen Apparaten
- Fertigung von Prototypen und Kleinserien aus verschiedenen Materialen aus verschiedenen Kunststoffen und Metallen
- Einsatz von 3D-Scannern und Rapidprototypern

Thank you very much for your kind attention !

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