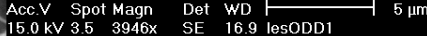
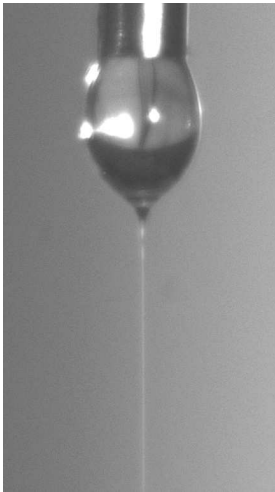
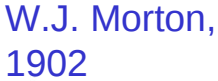


Entwicklung und Charakterisierung von Gerüstwerkstoffen aus Polysialinsäure

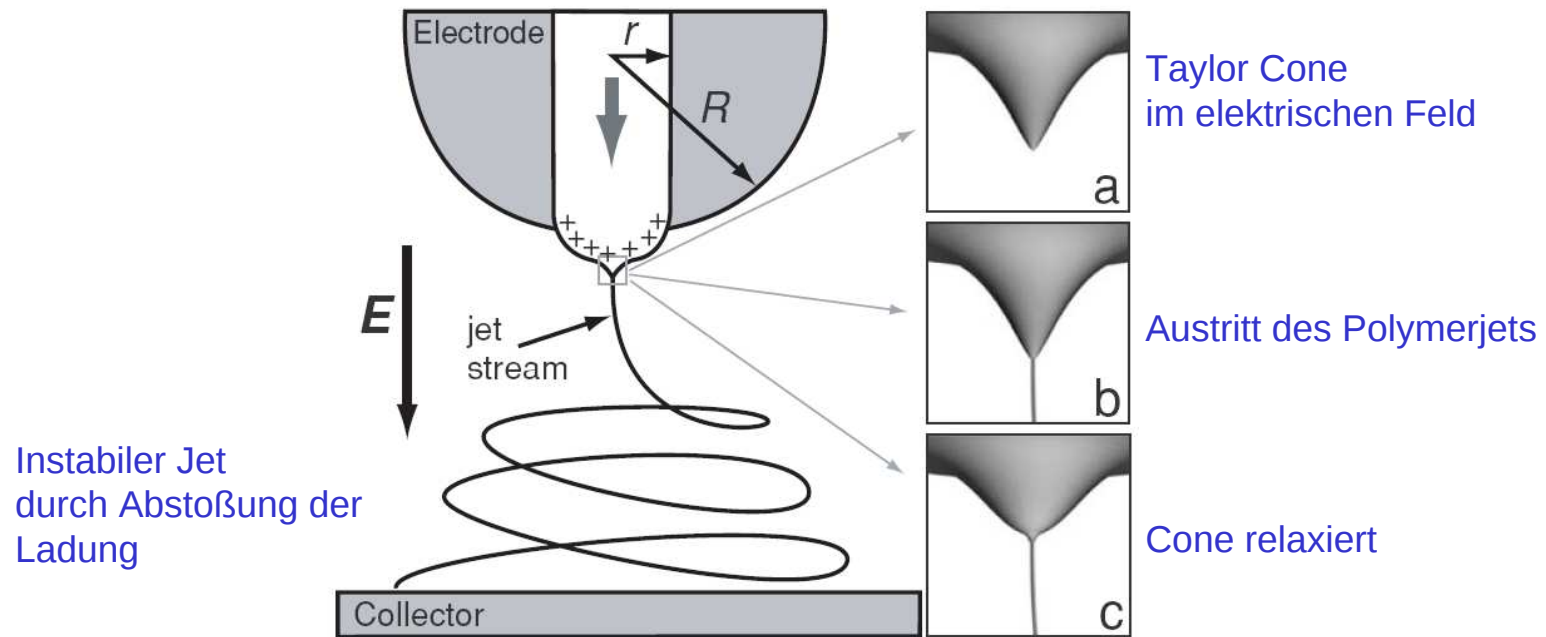
Ulrike Assmann, Robert H. Schuster
polySia Seminar, 16.12.2009
Hannover

Inhalt

- Elektrospinning
- Fasern aus Polyacrylnitril (PAN)
- Polyelektrolytbeschichtung (PAN-PLL-PSA)
- PAN mit MCM-41



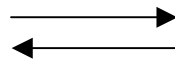
Entstehung des Jets



Elektrische Feldstärke

$$E \sim \epsilon U^2 / L^2$$

Permittivität - ϵ
 Abstand der Elektroden - L
 Angelegte Spannung - U



Kapillarkraft

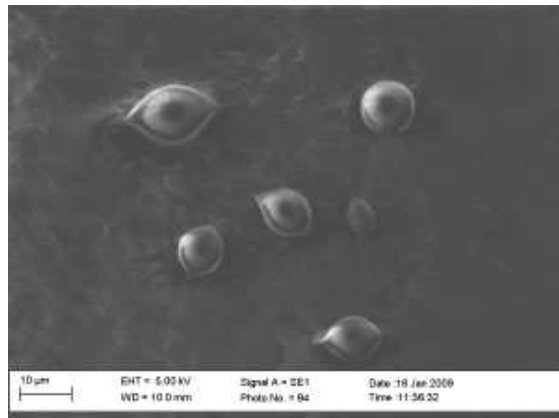
$$\kappa \sim \gamma / r$$

γ - Oberflächenspannung
 r - Radius des Tropfens

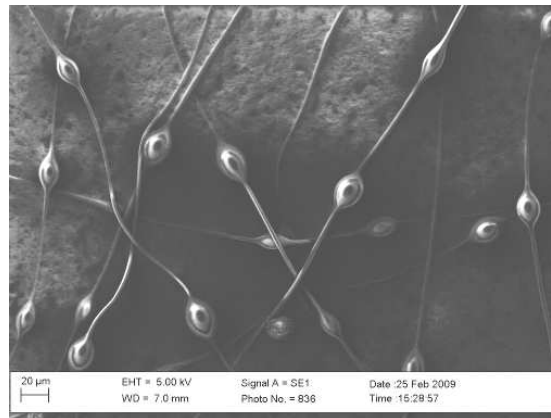
$$U_k \geq L(\gamma / \epsilon r)^{1/2}$$

Stabilität des Elektrospinningprozess

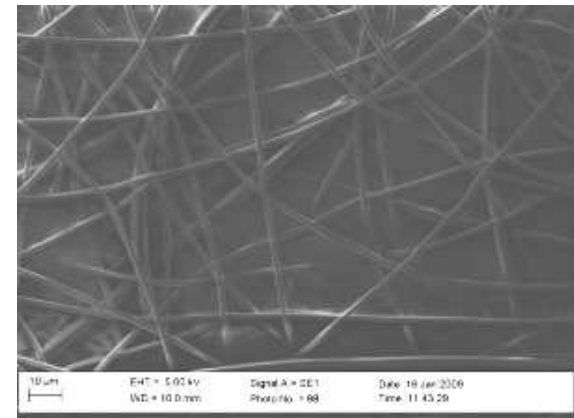
Elektrospray
Tropfen



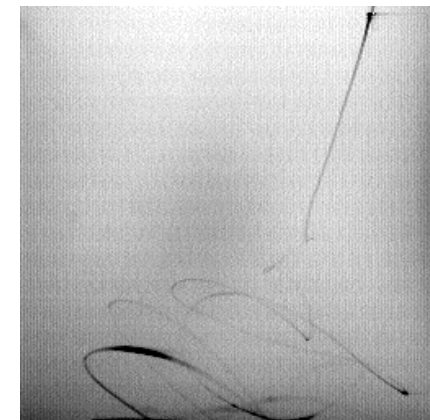
Elektrospinning
Perlenkette



Fasern

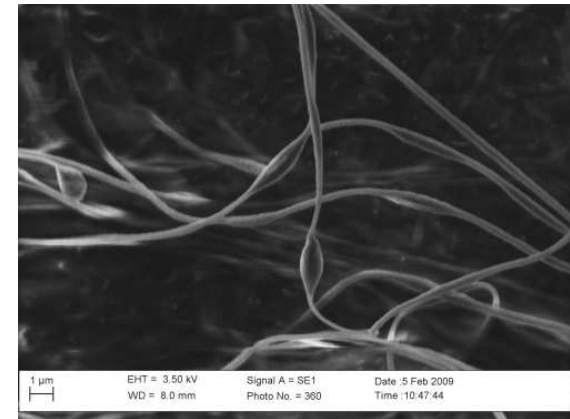
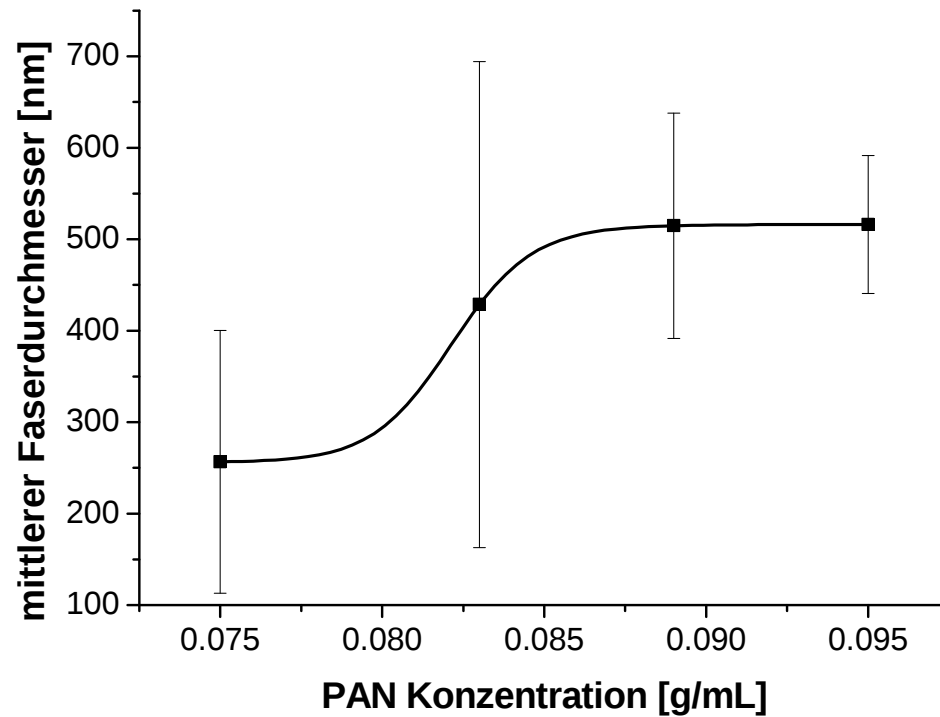
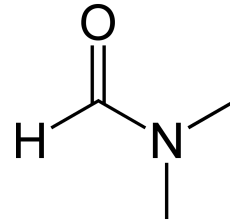
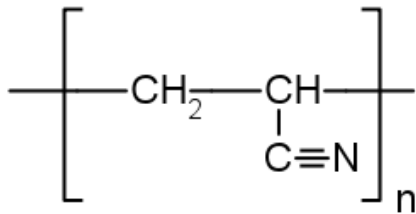


Kowalewski et al.,
IPPT,
Polish academy of science

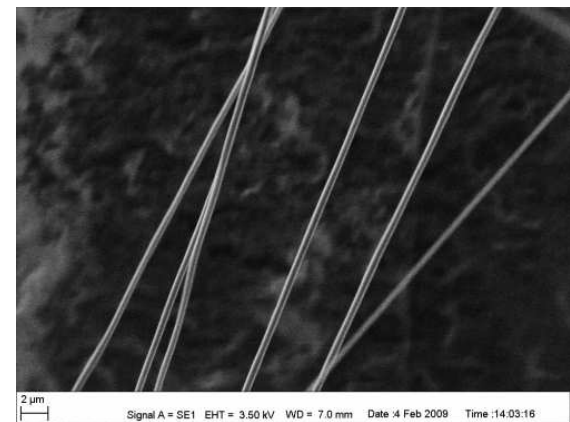


Polyacrylnitril

PAN in Dimethylformamid

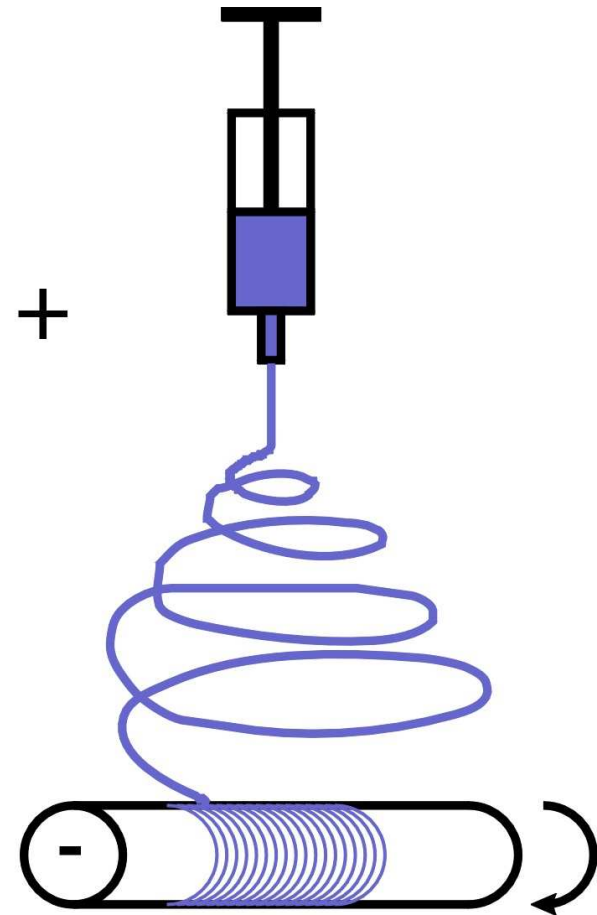
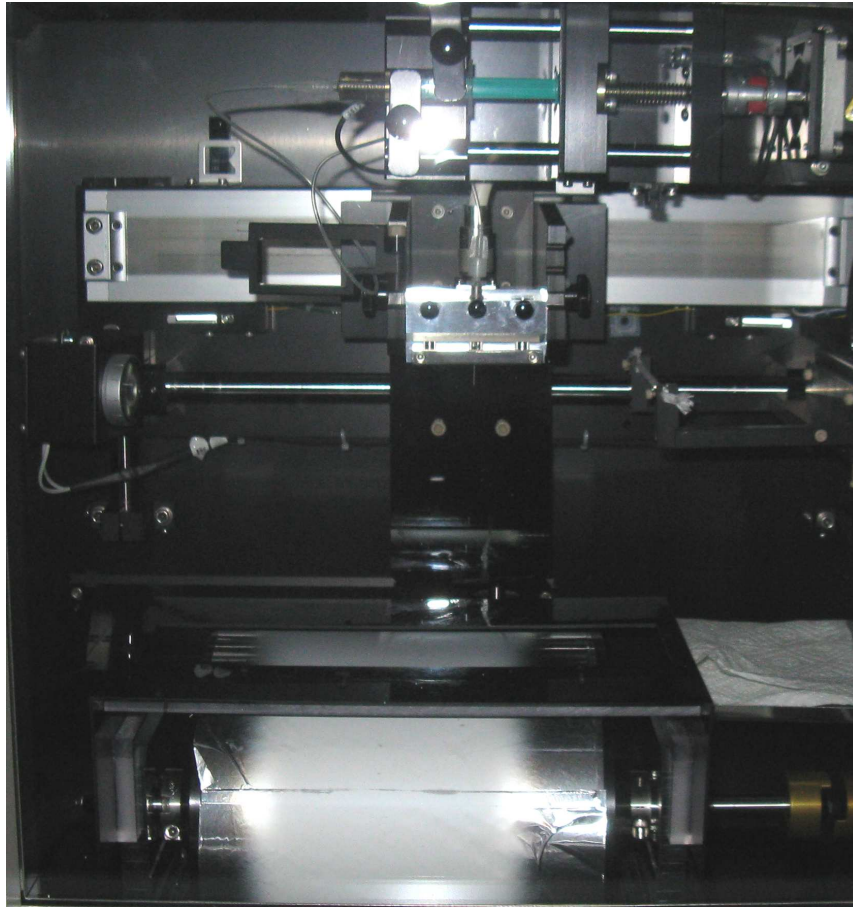


0,083 g/mL

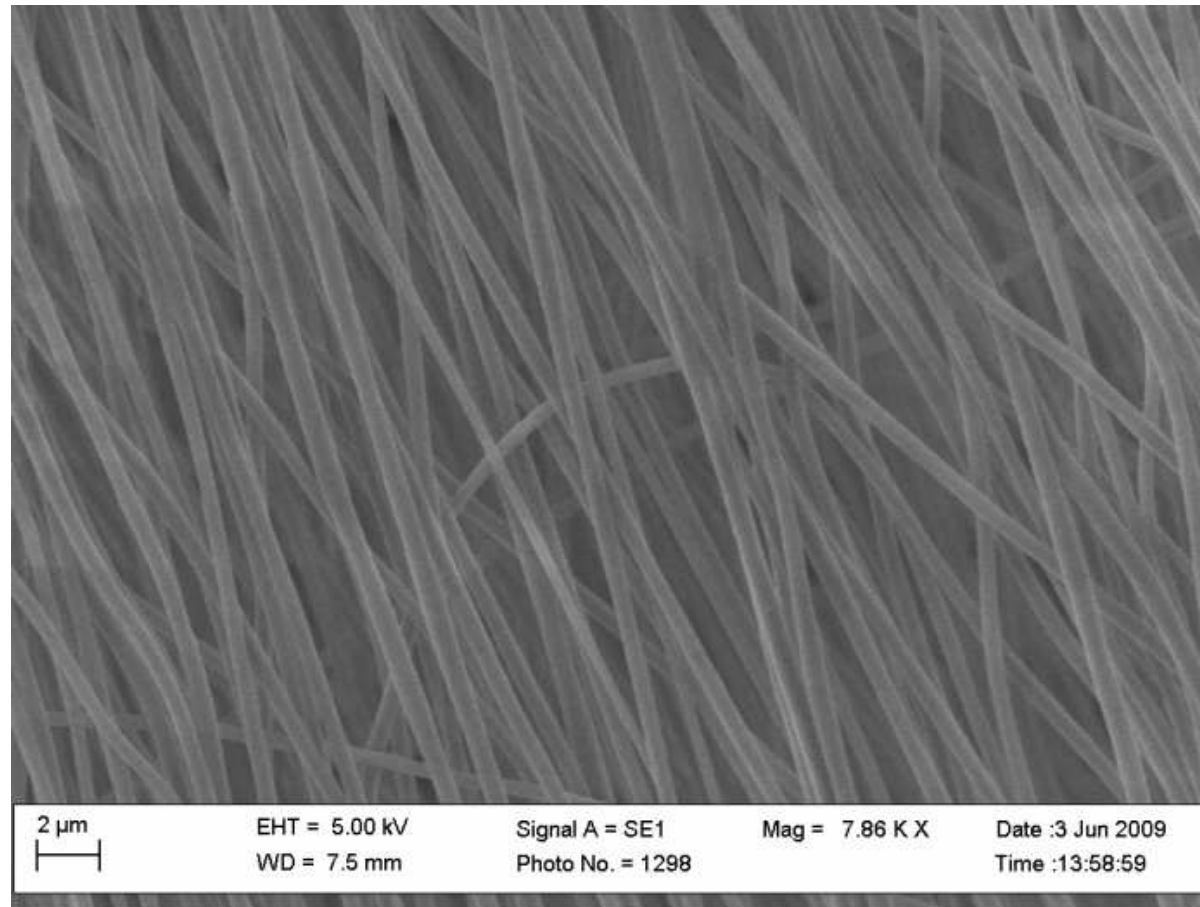


0,095 g/mL

Gerichtete Polyacrylnitril-Fasern

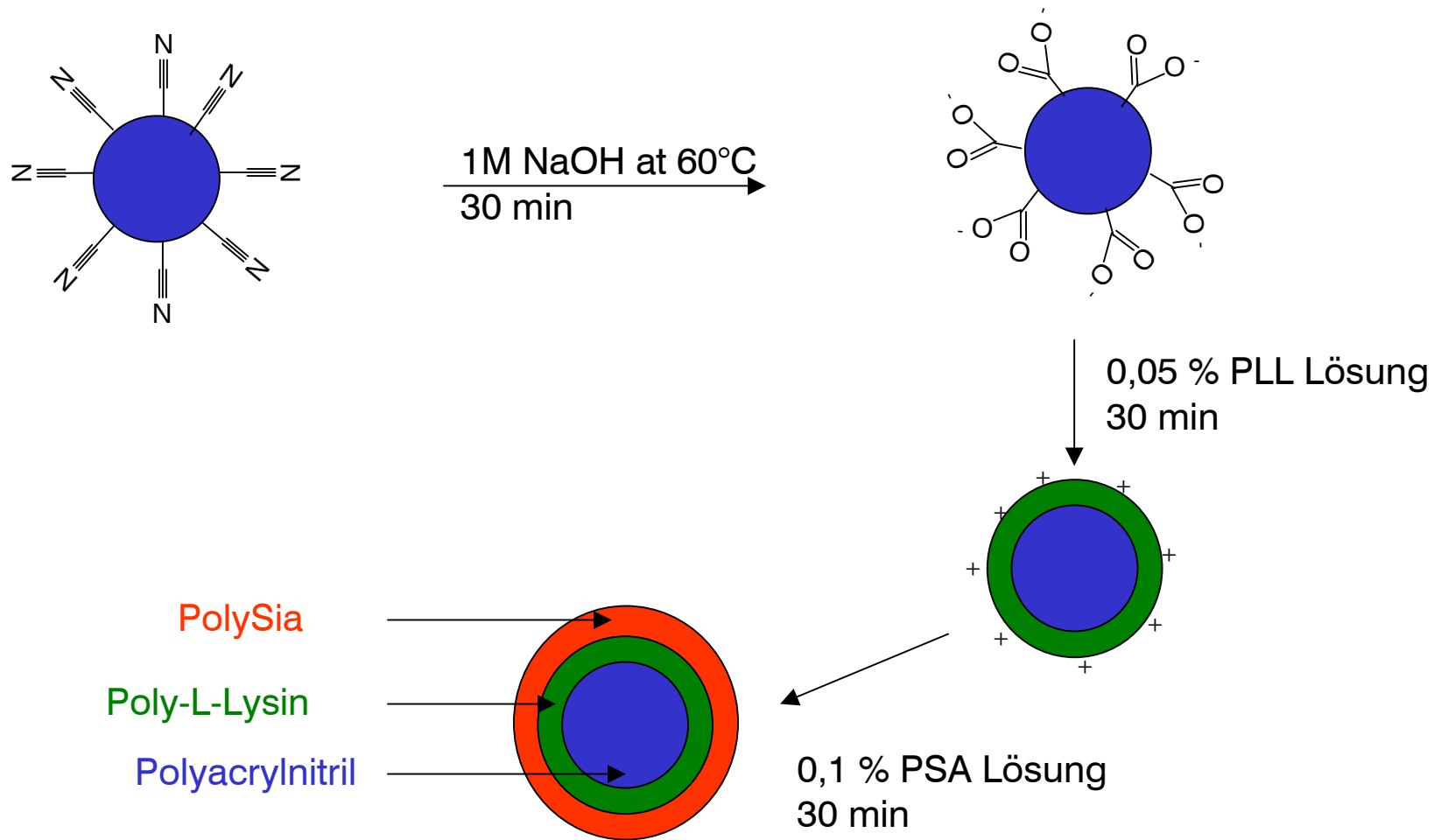


Gerichtetes Polyacrylnitril

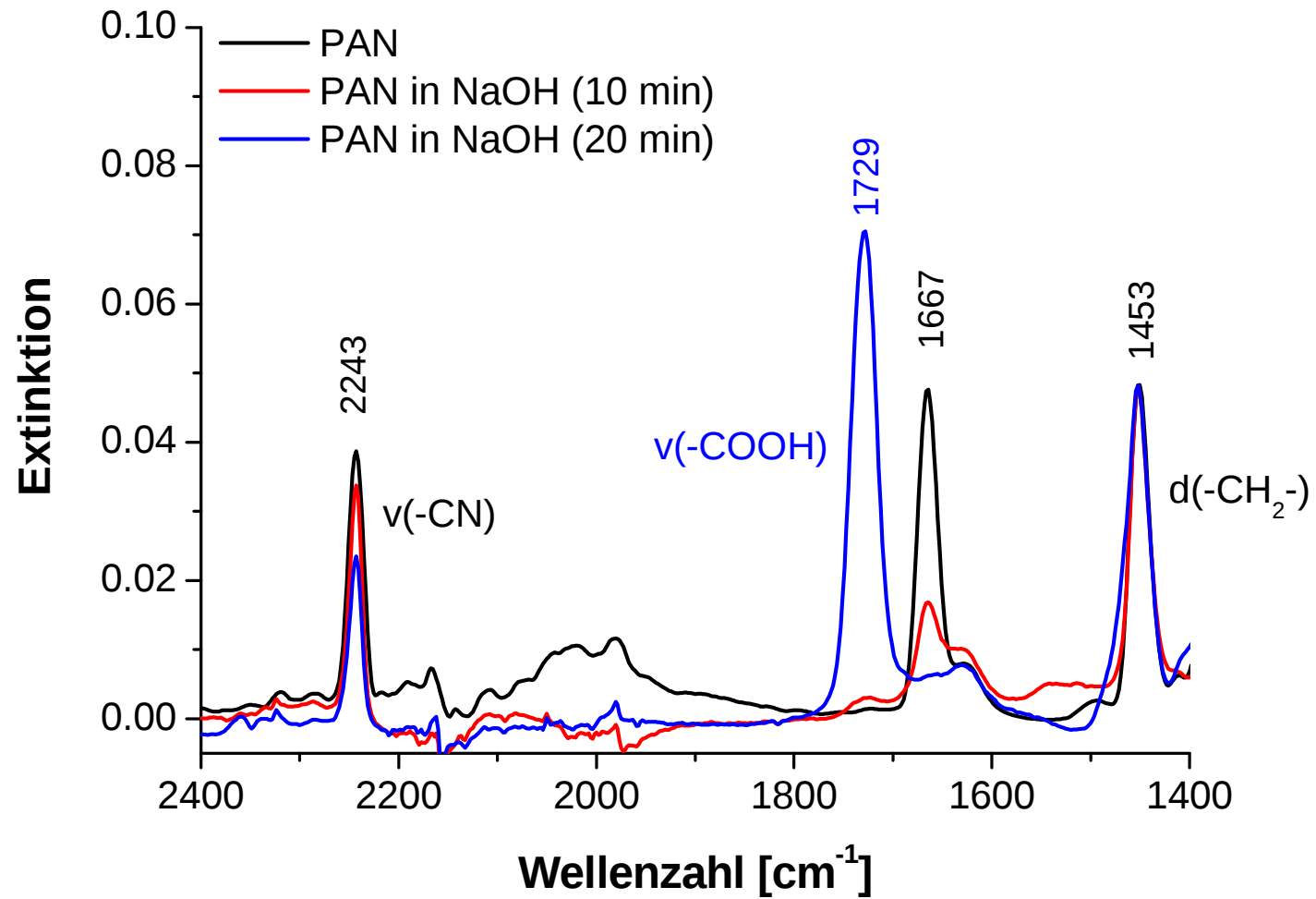


1000 U/min → 10 m/s

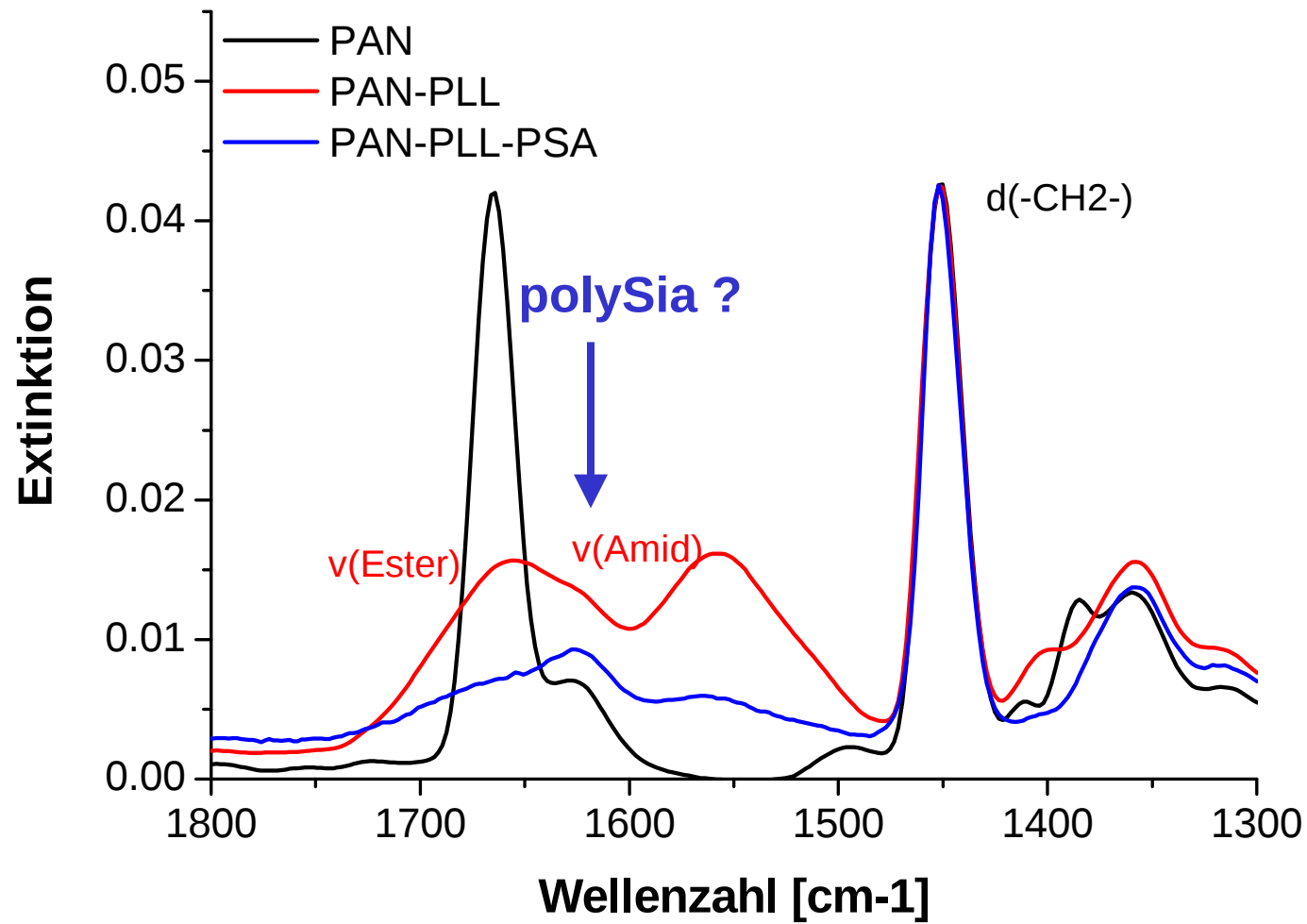
Polyelektrolyt beschichtetes PAN



IR

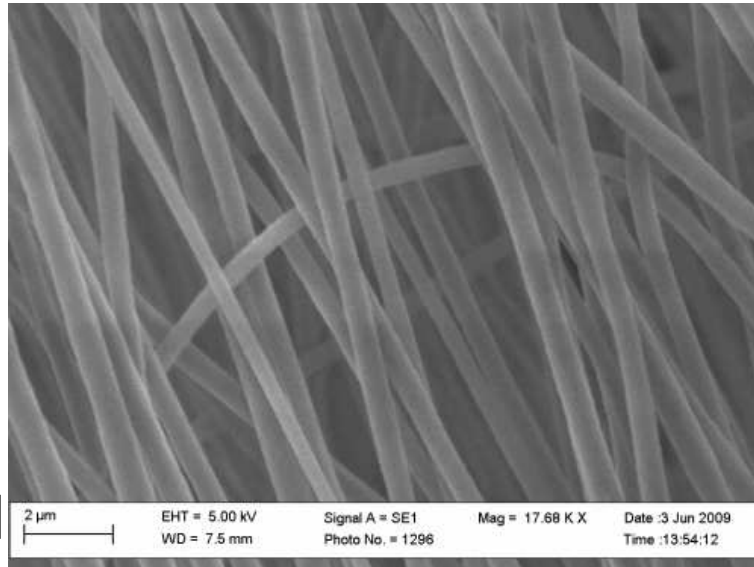


IR

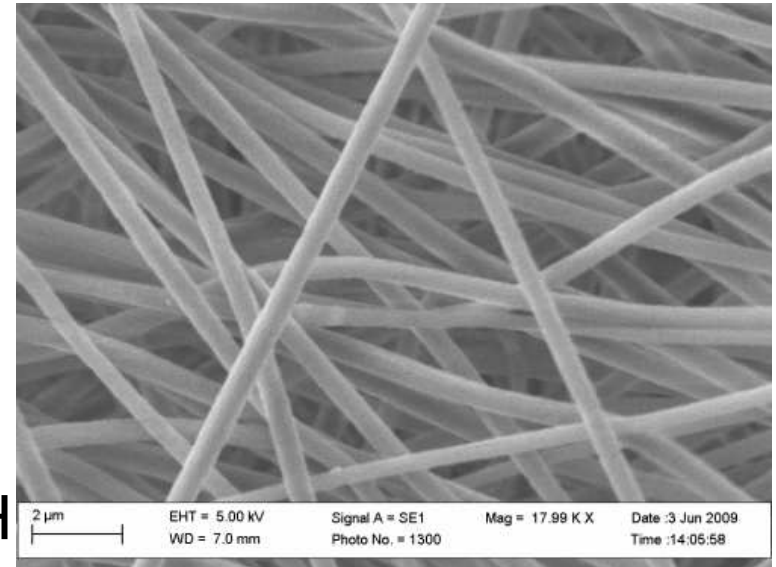


REM

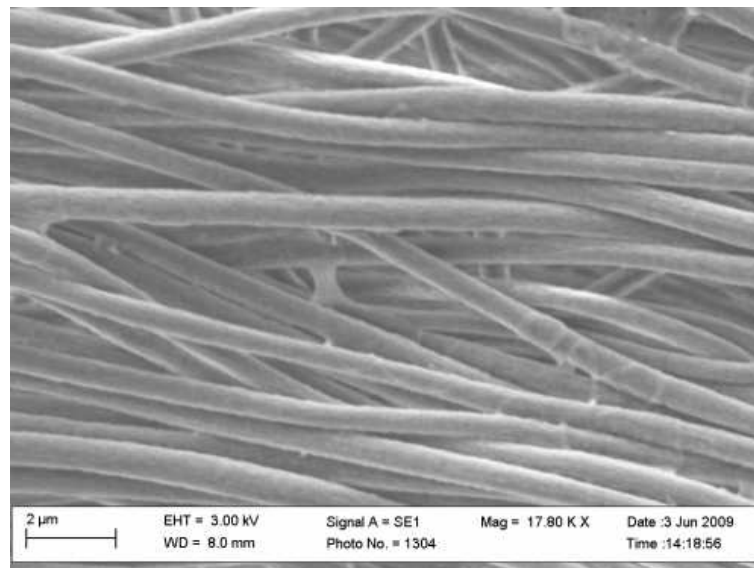
PAN



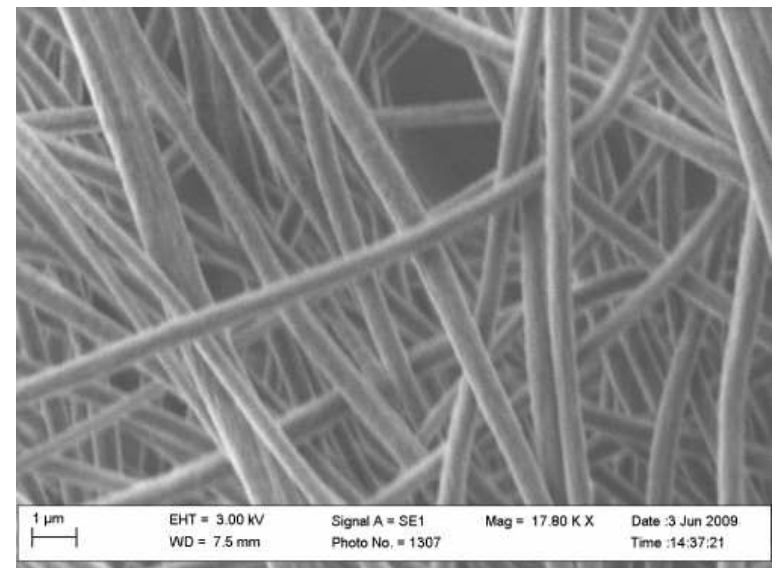
-COOH



+PLL

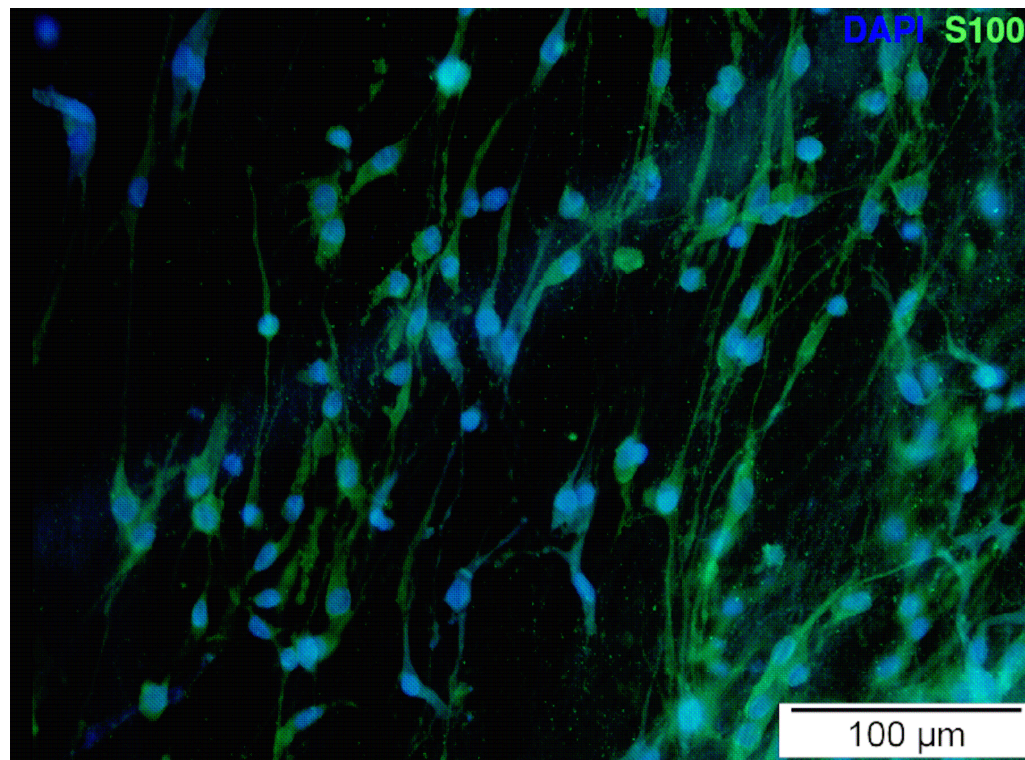


+PSA



Zelltests

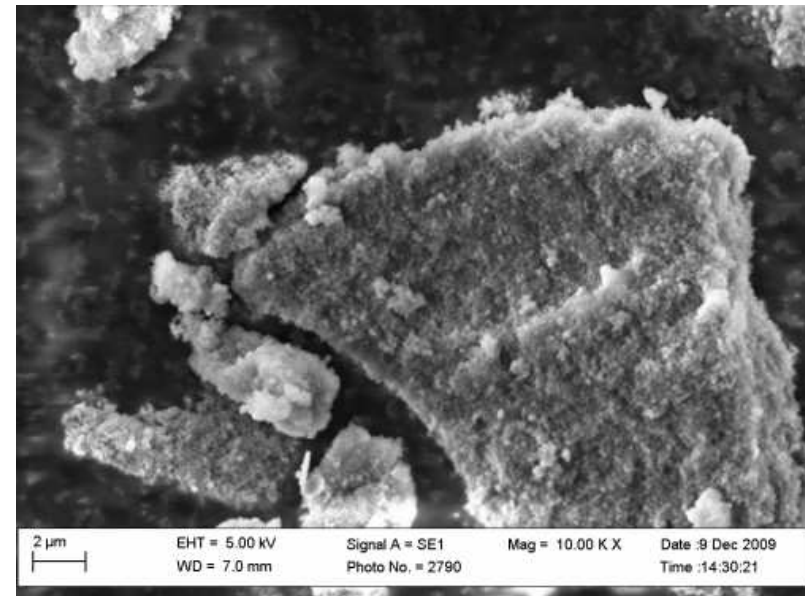
- In- vitro Tests mit Schwann-Zellen waren positiv
- In-vivo Tests zeigten starke Entzündungsreaktionen



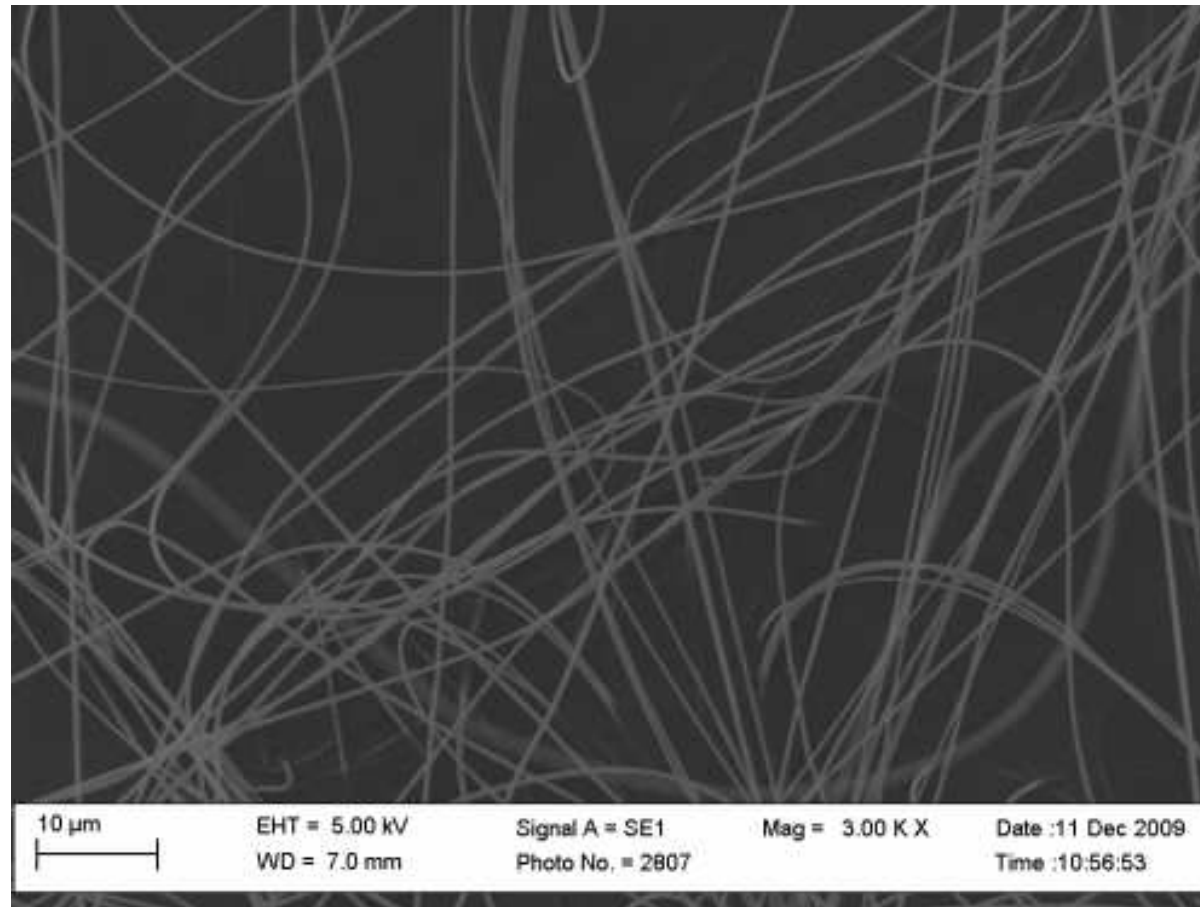
Schwann-Zellen
auf PAN-PLL-PSA

PAN mit MCM-41

- MCM-41 meso-poröses Silika mit polySia beschichtet von Sina Williams (AK Behrens)
- PAN in DMF gelöst und MCM-41 mit Ultraschall dispergiert.
- Elektrospinning Parameter: 18 kV, 30 cm, 0.5 ml/h

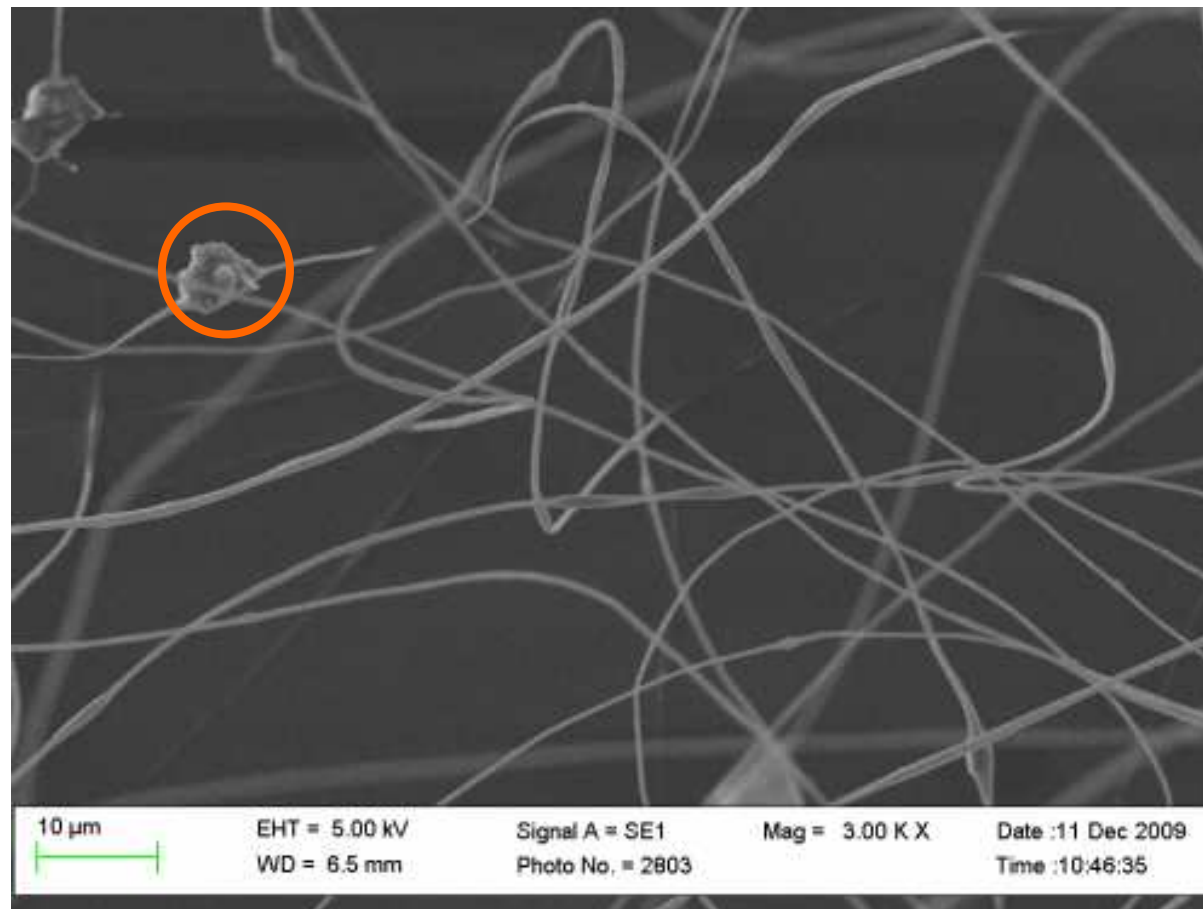


PAN ohne MCM-41



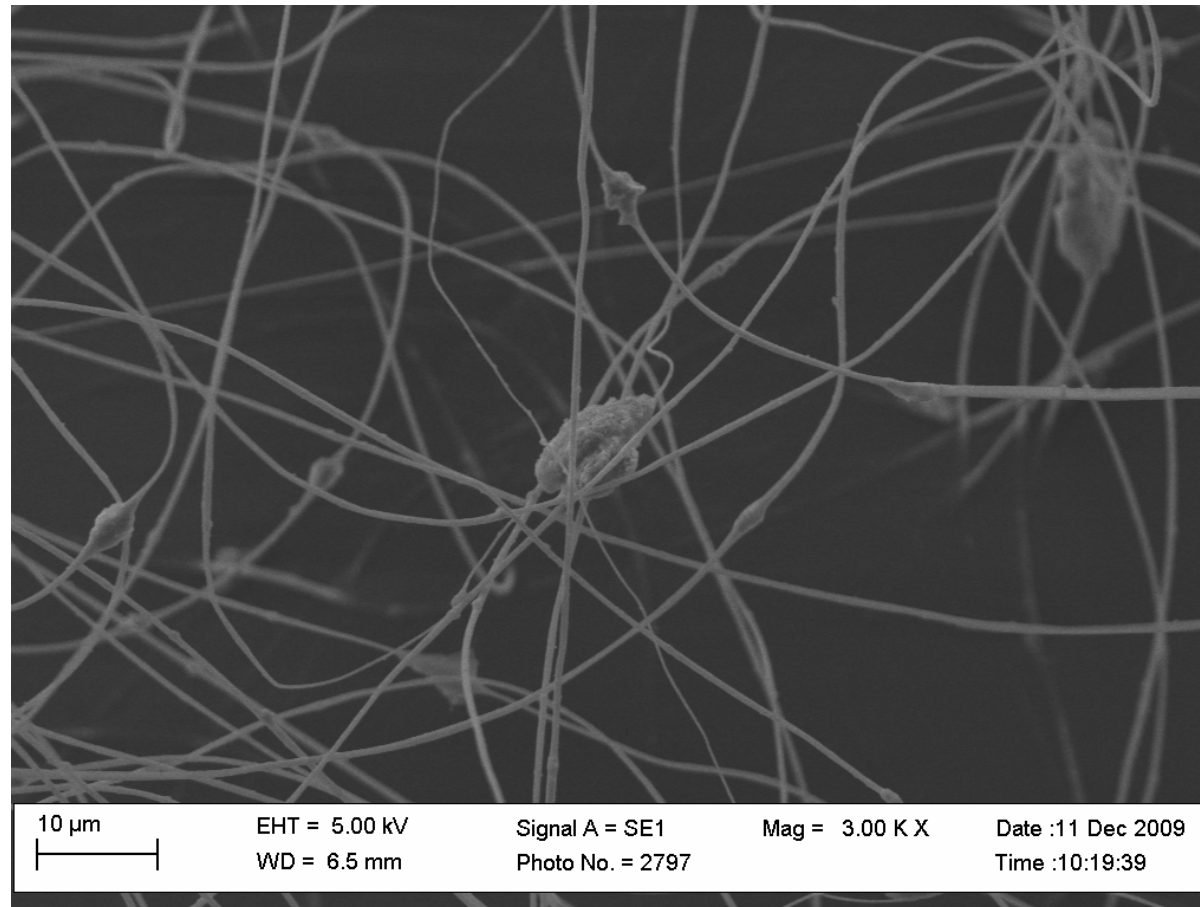
PAN ohne MCM-41

PAN mit MCM-41



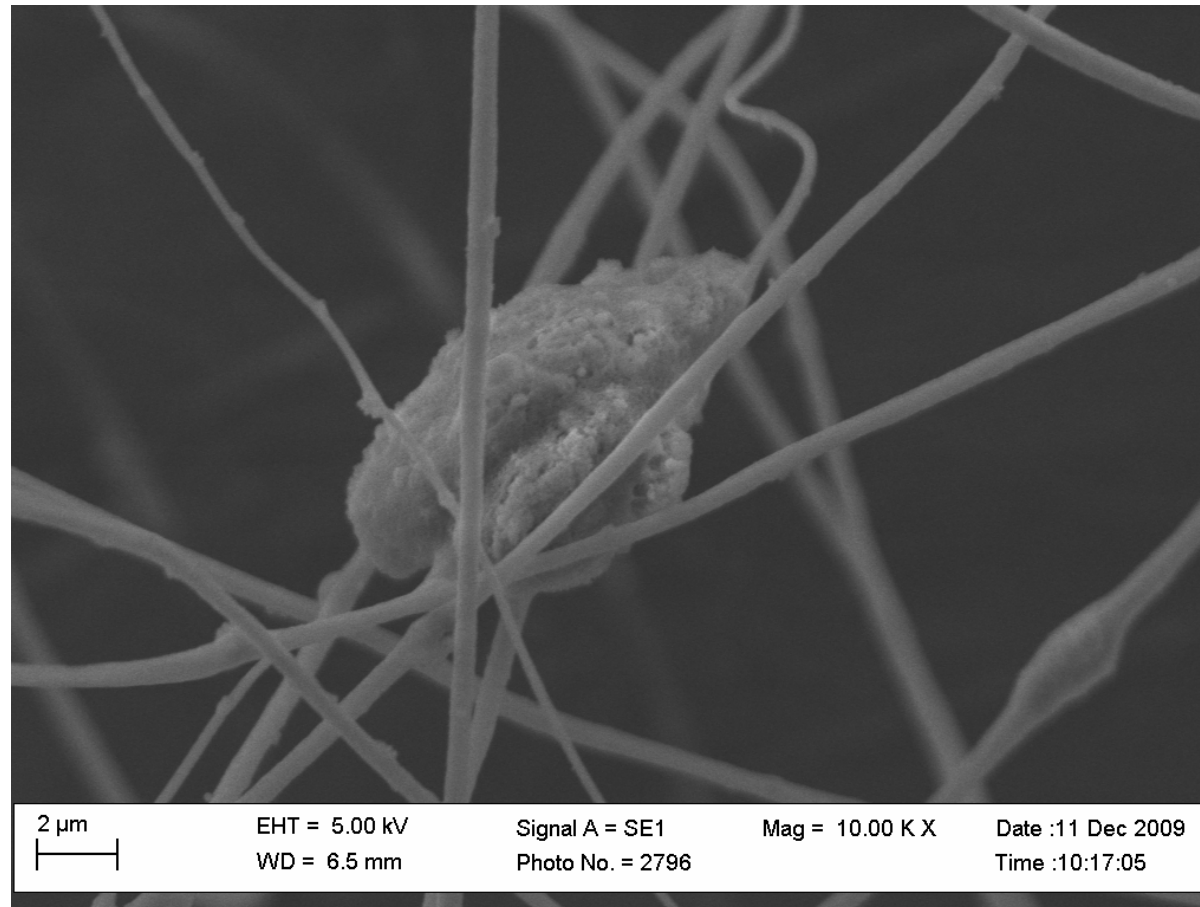
PAN + 19 wt(%) MCM 41

PAN mit MCM-41



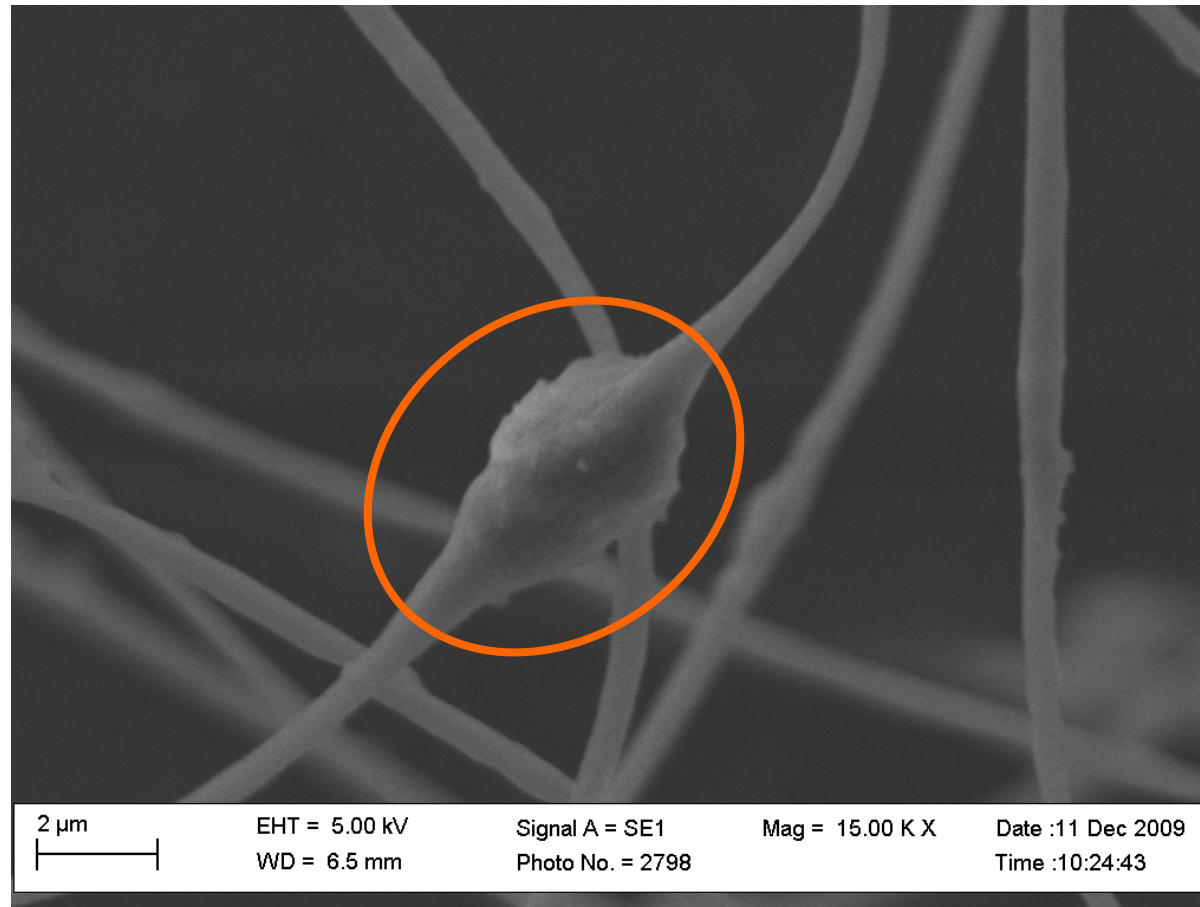
PAN + 32 wt(%) MCM 41

PAN mit MCM-41



PAN + 32 wt(%) MCM 41

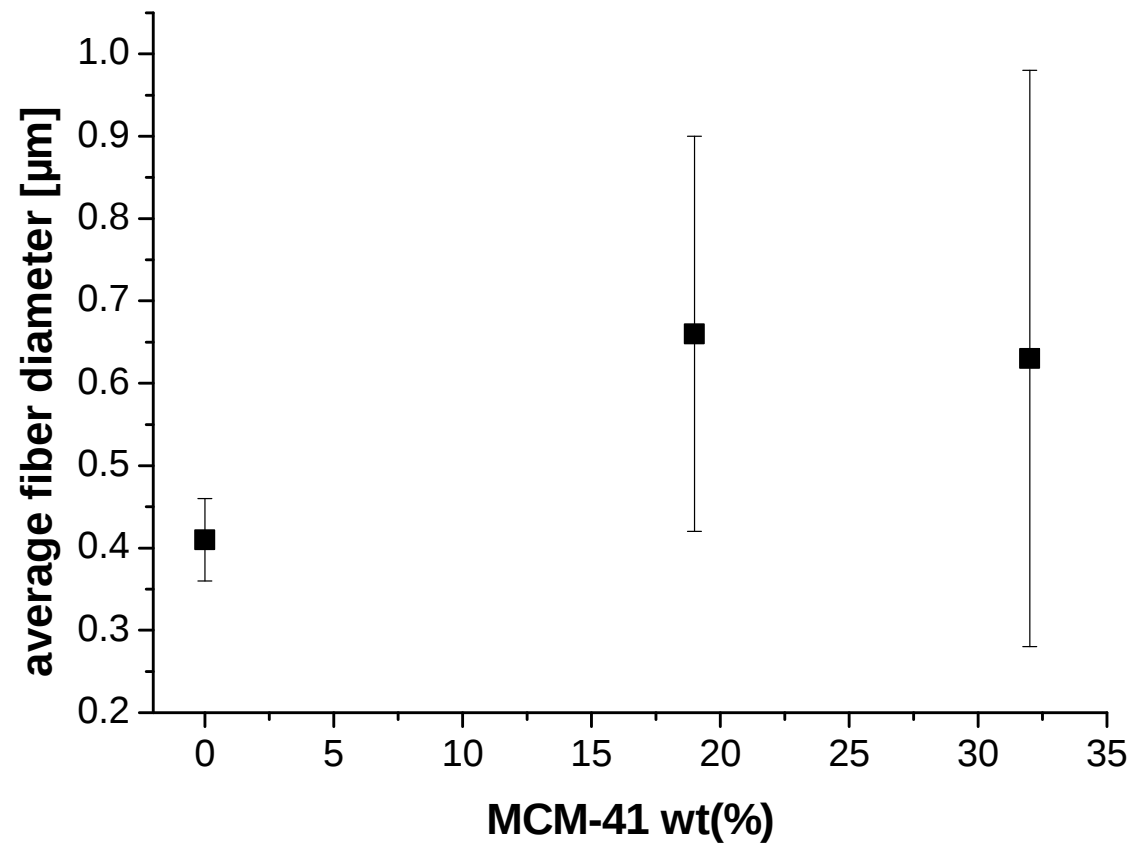
PAN mit MCM-41



PAN + 32 wt(%) MCM 41

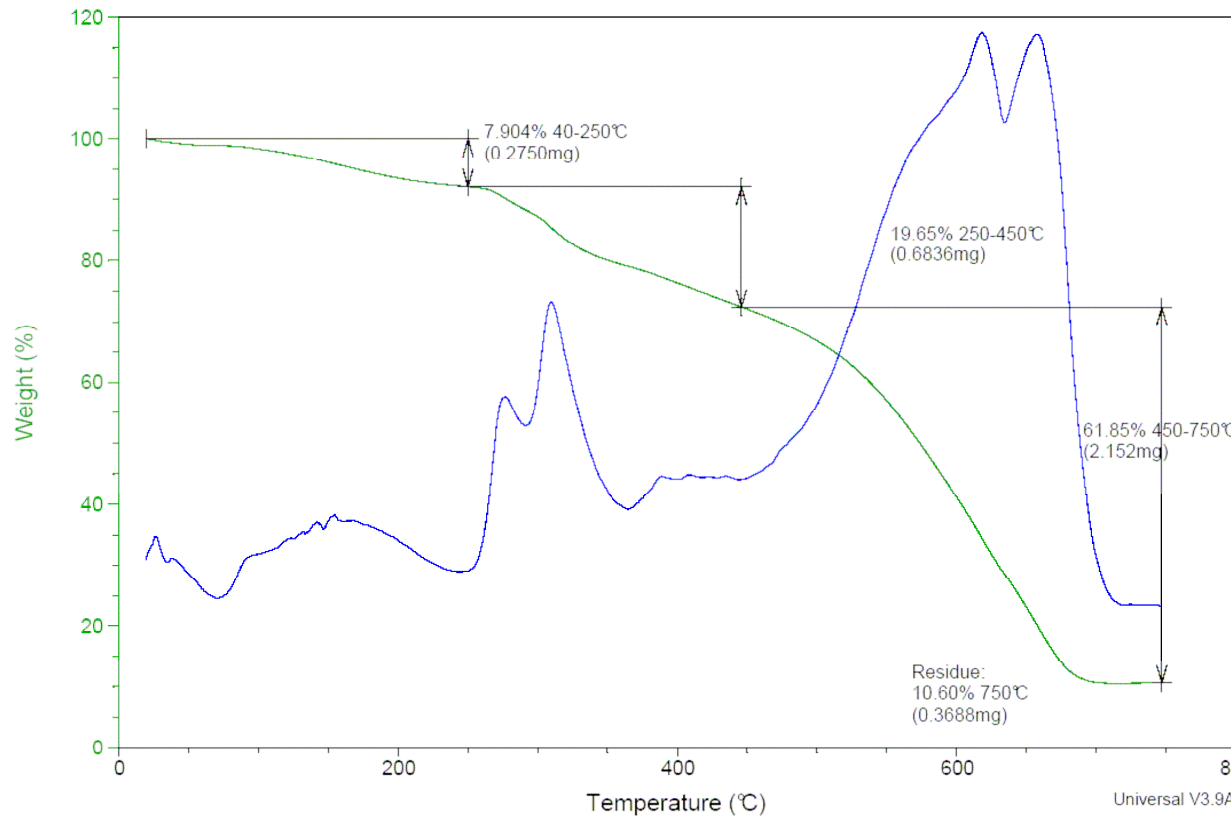
Faserdurchmesser

mit zunehmender MCM-41 Konzentration



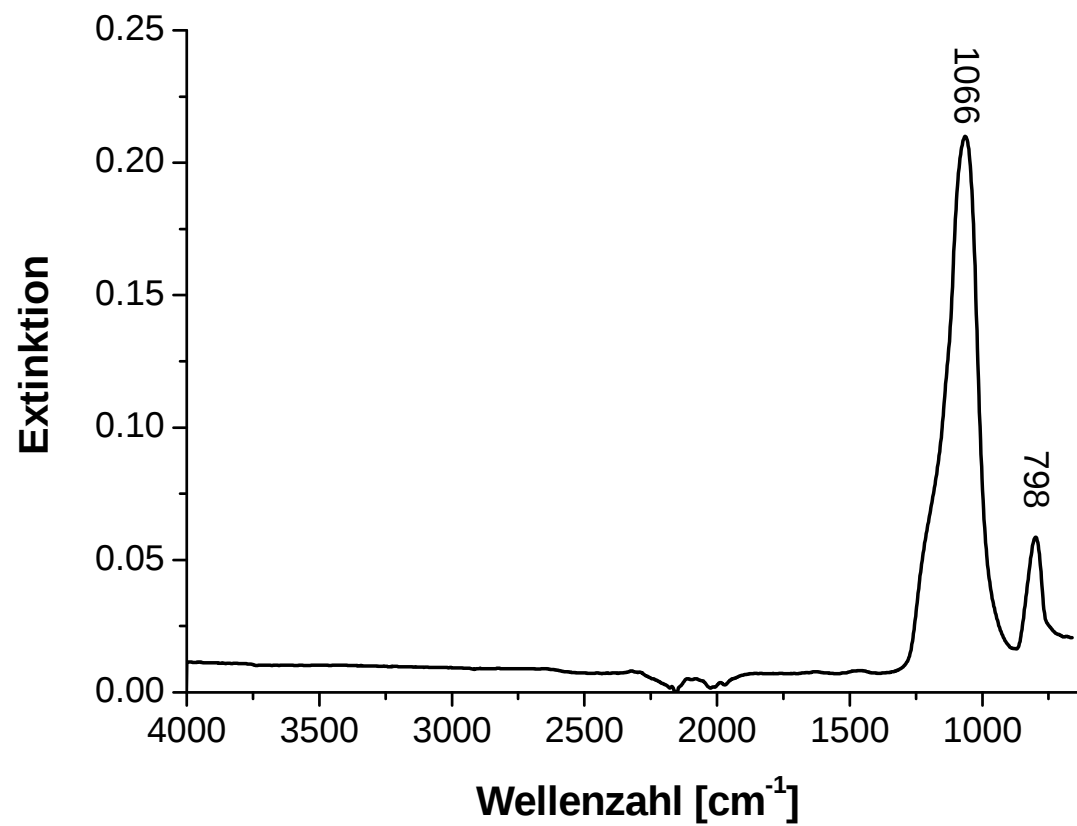
TGA Messung

PAN + 32 wt (%) MCM 41 + polySia,
10°C/min, 40-750°C Luft



TGA Ergebnis:
11-12 wt (%) MCM 41

TGA Rückstand



⇒ SiO₂

Zusammenfassung

- PAN
 - Beschichtung oder Anbindung von polySia ist möglich.
 - Entzündungsreaktionen (in-vivo)
- Verspinnen von beschichtetem MCM-41
 - MCM-41 befinden sich teilweise auf der Oberfläche der Fasern.
 - Geringere MCM-41 Konzentration in den Fasern als bei der Einwaage.
 - Faserdurchmesser nimmt mit MCM-41 zu.
 - Perlenkettenmorphologie bildet sich.