Polymer Surfaces and Coatings

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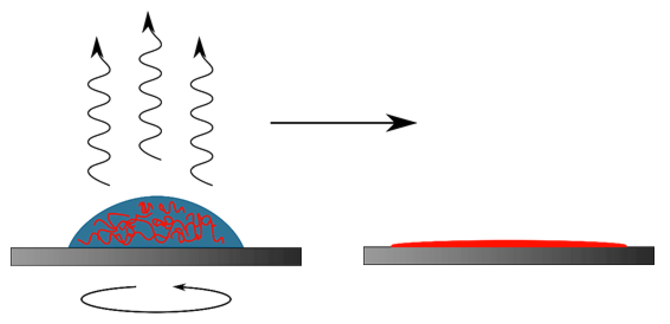
Preparation Procedures

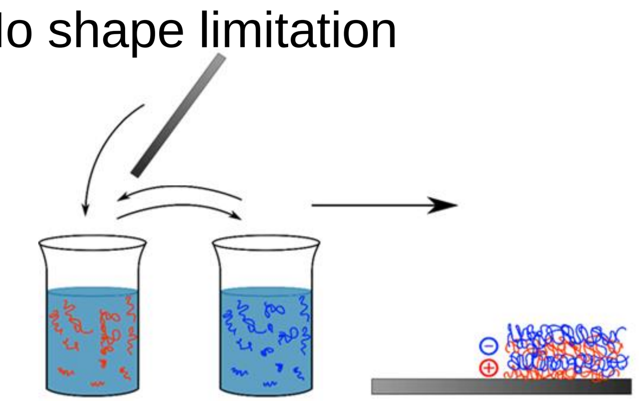
Spin Coating

- Spin cast solutions or suspensions on flat substrates
- Centrifugal forces distributes, thins and dries film



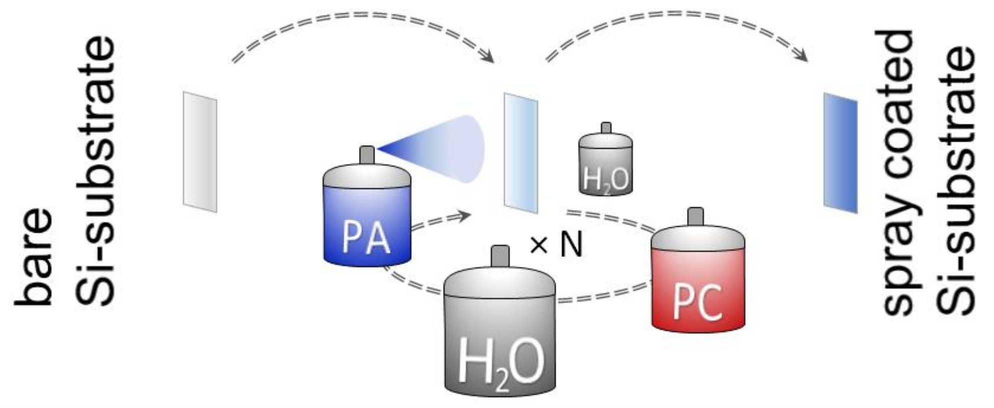
Dip Coating

- Layer-by-Layer (LbL)
- Self assembly of charged particles adsorbed from aqueous solutions
- No shape limitation



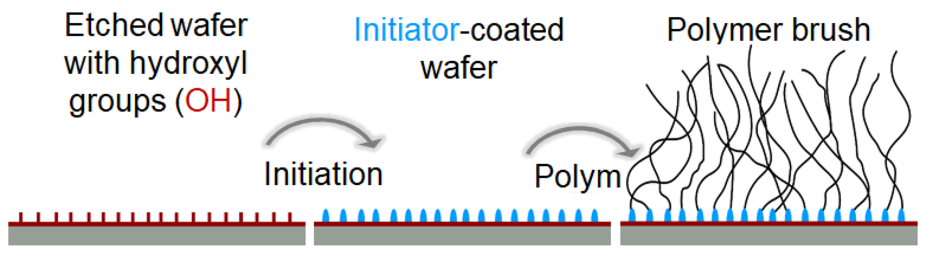
Spray Coating

- Quick LbL-technique
- Forced assembly
- Targeted orientation



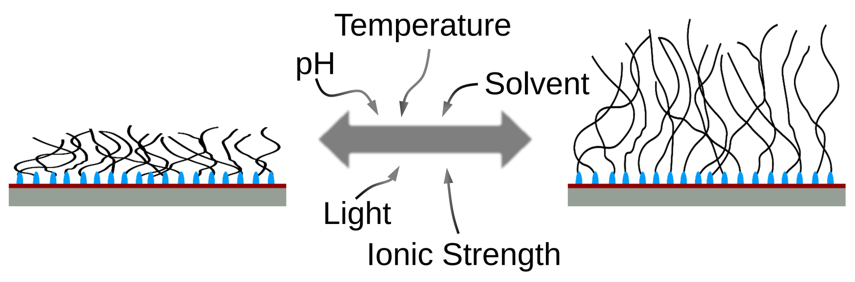
SI-ATRP: Surface-initiated atom transfer radical polymerization

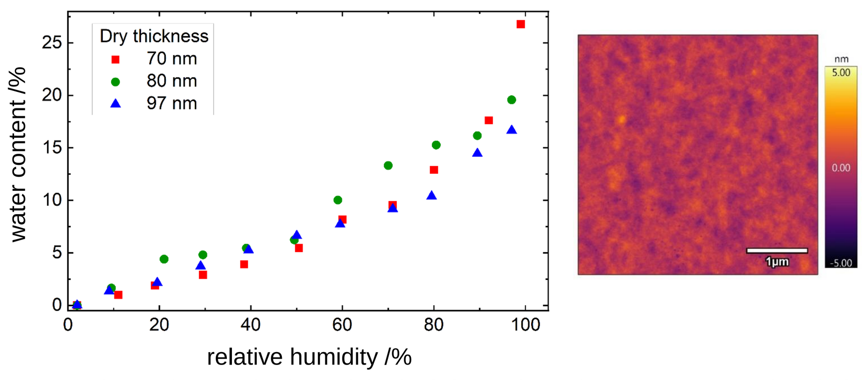
- Two-step procedure
- Dense grafting of polymer chains
- Control: initiator density, chain length
- Monomer choice: chemical properties



Polymer Brushes (PBs)

Sensitivity to external stimuli

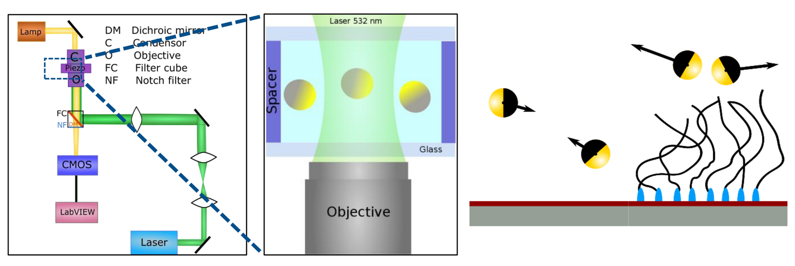




Swelling of PBs in humid air (L) and surface topography (R)

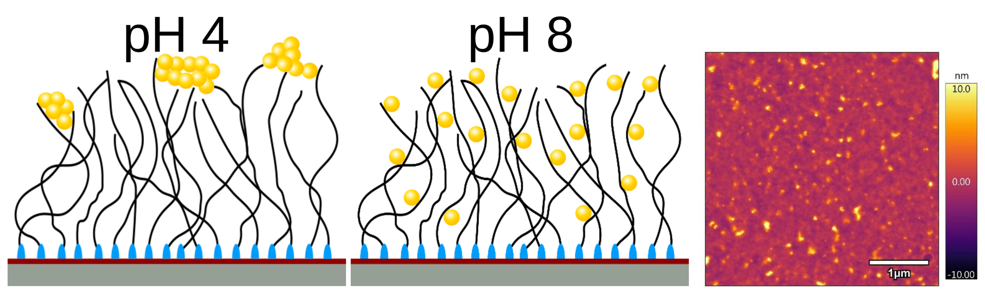
- Reversible response
- Control: Surface properties

Modification of substrate for self-propulsion measurement



- Thermophoretic velocity of PS-Au Janus particles enhances near a brush-functionalized substrate
- Particle velocity depends on the boundary condition at the glass/water interface as well as on roughness, friction and wettability of the substrate

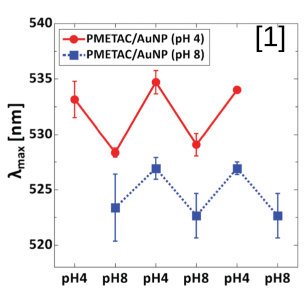
PB/Gold Nanoparticle (AuNP) Composites

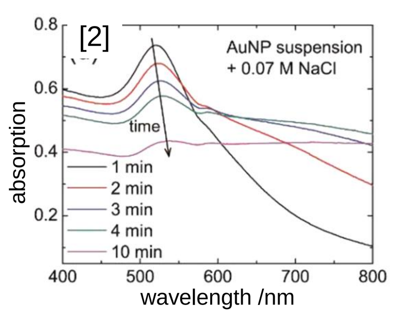


Composite structure: schematics (L+M) and surface topography (R)

- AuNP suspension: pH-dependant surface charge
- Absorption of visible light
- Composites by self-assembly

- Incubation parameters: structure formation
- Structure dependant light absorption
- Reversible pH-responsive structure [1]
- (Ir-)reversible particle aggregation [2]

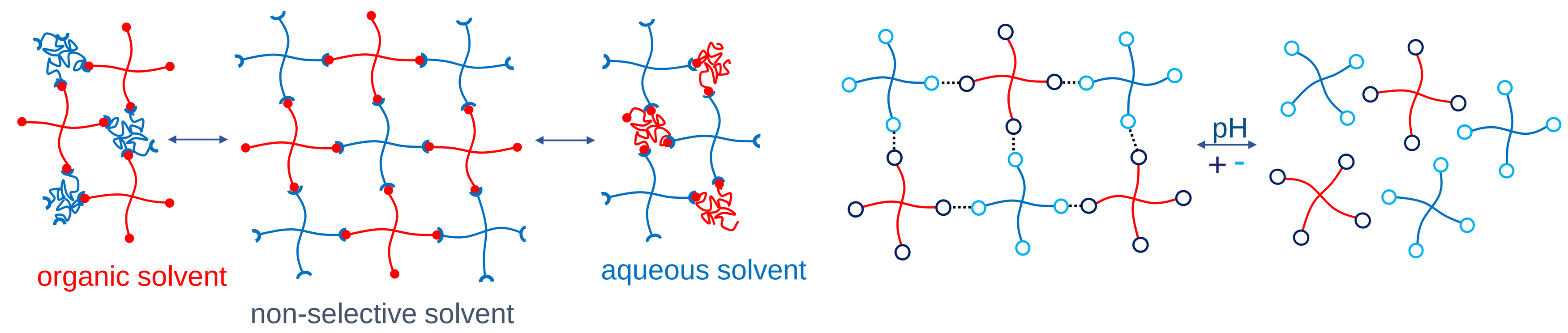




Amphiphilic Polymeric Networks (ACNs)

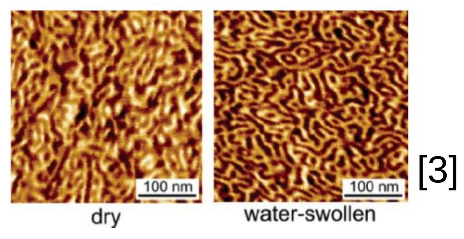
Hydrophilic and hydrophobic tetra-PEG-PCL Co-polymers

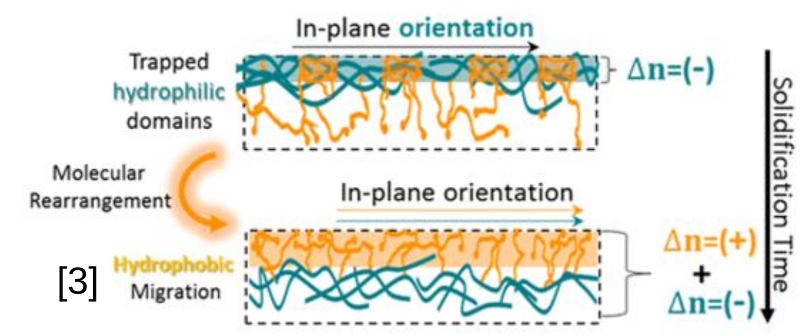
covalent bonding (permanent) *electrostatic interaction (reversible)*



Surface characterization

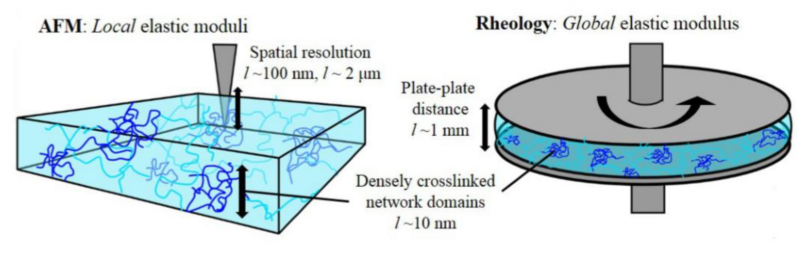
- Control and understanding of structure, mechanics and nano-rheology at the interfaces of ACNs





- Structural changes of ACNs at the interface are a result of different environments such as solvent type, pH or temperature

- AFM indentation experiments: Elastic and dynamic properties of ACN gel films on a nano/microscopic scale

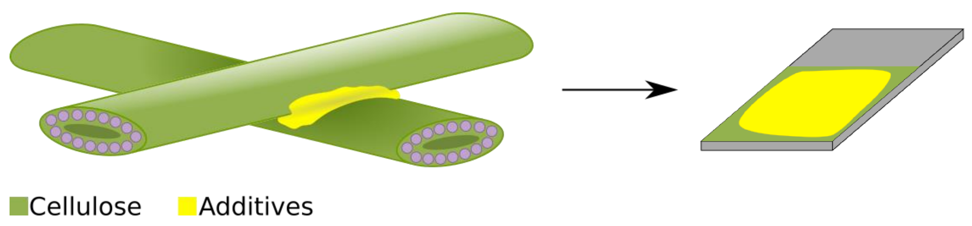


Local (AFM – tip, µm-probe) vs. global moduli

Cellulose Model Surfaces (CMSs)

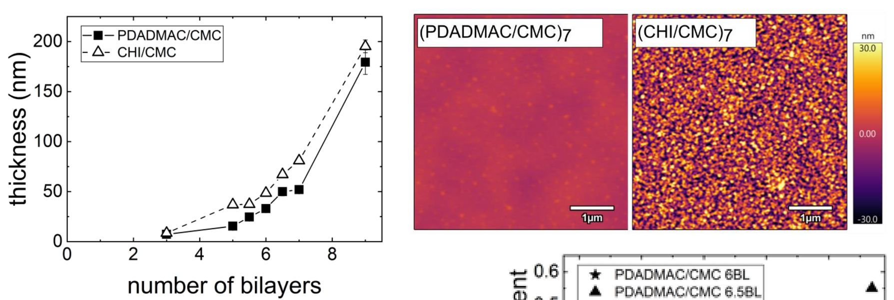
Functional Paper

- Increasing wet-strength using functional polymers
- Alter additives to tune interactions between cellulose fibers for selective modification
- CMS as a model system of cellulose fibers to characterize interactions

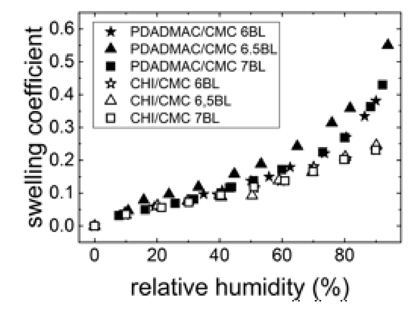


Preparation of CMS

… by dip coating of carboxymethyl cellulose (CMC) and polycations (PDADMAC & chitosan CHI) [4]

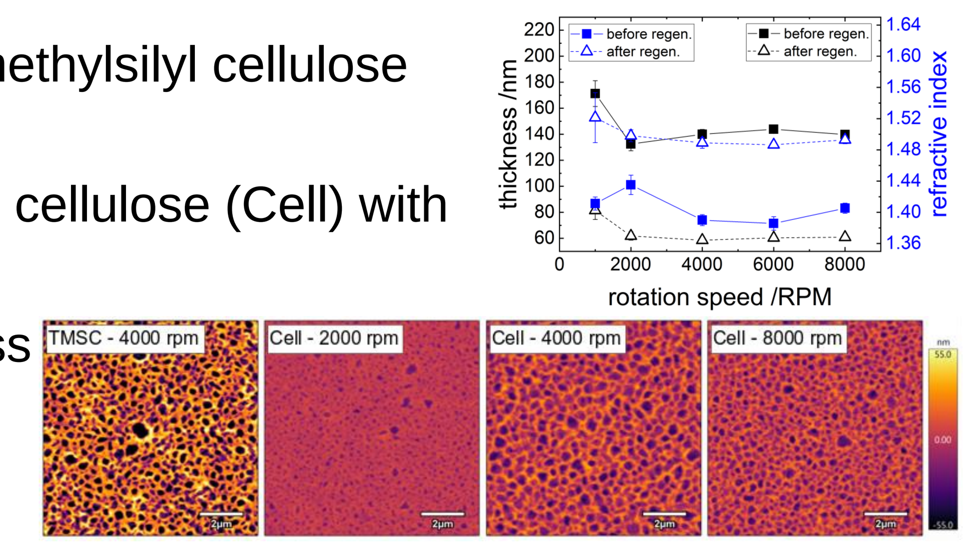


- Exponential growth of both PEMs
  PDADMAC: smooth and flexible films with higher water uptake
- CHI (weak polyelectrolyte): homogenous roughness



… by spin coating of derivate trimethylsilyl cellulose (TMSC)

- Successful regeneration back to cellulose (Cell) with stable morphology
- Porous topography and thickness tuneable through rotation speed



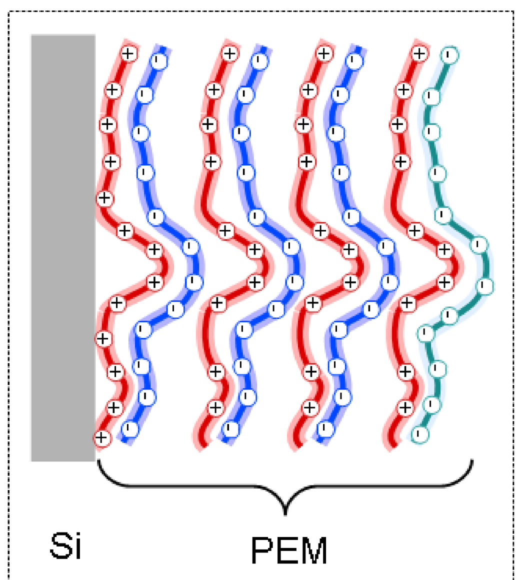
Interaction studies

Cooperations with AG Rehahn and AG Biesalski (Chemistry)

Polyelectrolyte Multilayer (PEM)

Model systems

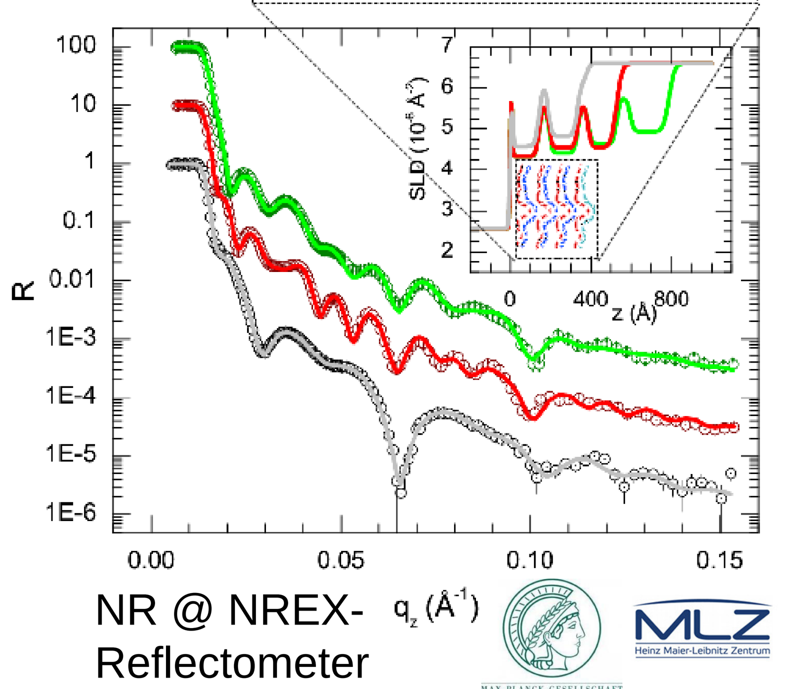
- Alter charge density (quarternization, pH)
- Screen electrostatic interactions (ions)
- Tune secondary interactions (solvent conditions, ion specific effects, temperature)



Deduce Scattering Length Density (SLD) using Neutron Reflectivity (NR)

- Build-up mechanism (linear vs. exponential thickness increase)
- Inner structure (partial deuteration to investigate layer interpenetration)
- Response to outer stimuli (exposure to temperature, moisture, water, pH, ions)

$$R(q_z) = \frac{R_F}{SLD_{Si}^2}\left|\int \frac{d}{dz} SLD(z) e^{-iq_z z} dz\right|^2$$



[1] Boyaciyan *et al.* Soft Matter, 2018, 14, 4029−4039. [2] Christau *et al.* Macromolecules 2017, 50, 7333−7343. [3] G. Guzman *et al.* Langmuir, 2016, 32, 3445. [4] Lux *et al.* Polymers, 2021, 13(3), 435.