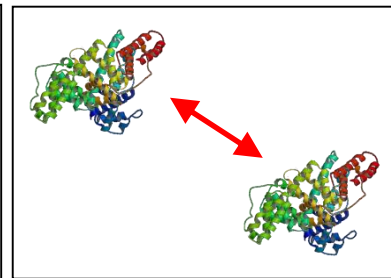
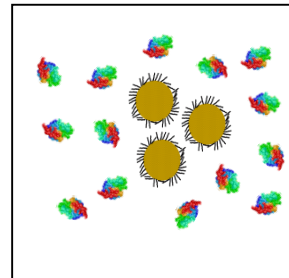
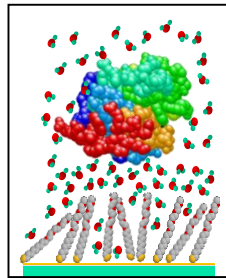
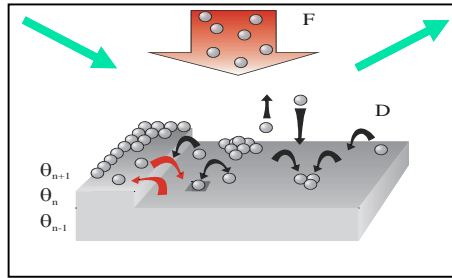
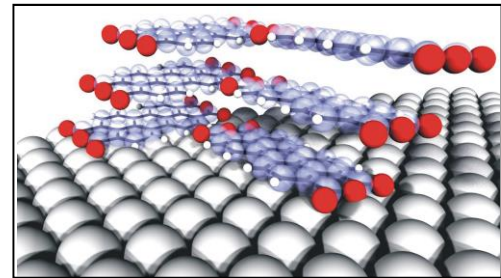


# Molecular and Biological Matter

## "Nano-Science in Motion"



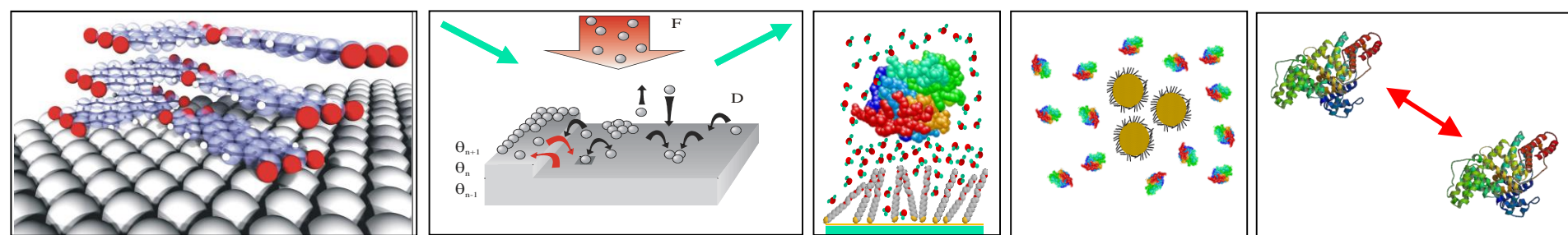
Frank Schreiber

<http://www.soft-matter.uni-tuebingen.de>

# Molecular and Biological Matter

## "Nano-Science in Motion"

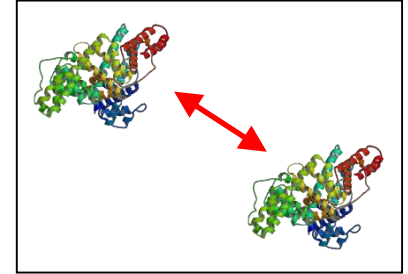
- Was erwarte ich von meiner Bachelorarbeit ?
- Welche Themen gibt es ?
- Wie wähle ich „mein Thema“ aus ?
- Was sind die Kriterien zur Auswahl ?
- Wie läuft die Arbeit in der Praxis ?
- Was muss ich sonst noch wissen ?



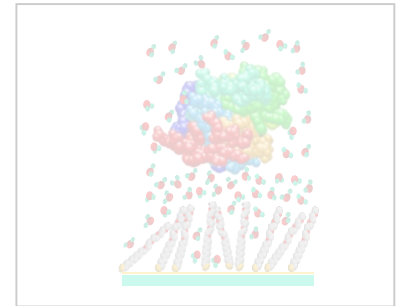
# Molecular and Biological Matter

## Protein Biophysics: Bulk / Dynamics

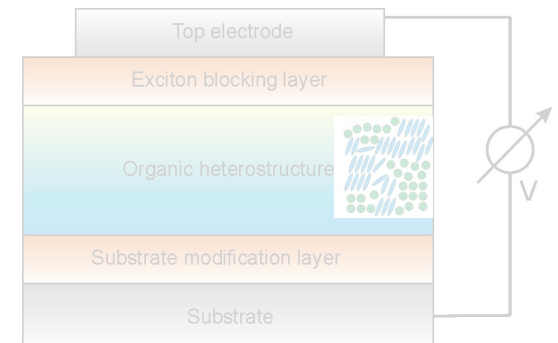
(see also Fajun Zhang / see also collaboration with Grenoble)



## Protein Biophysics: Interfaces

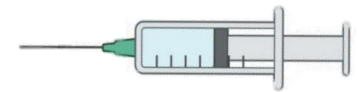
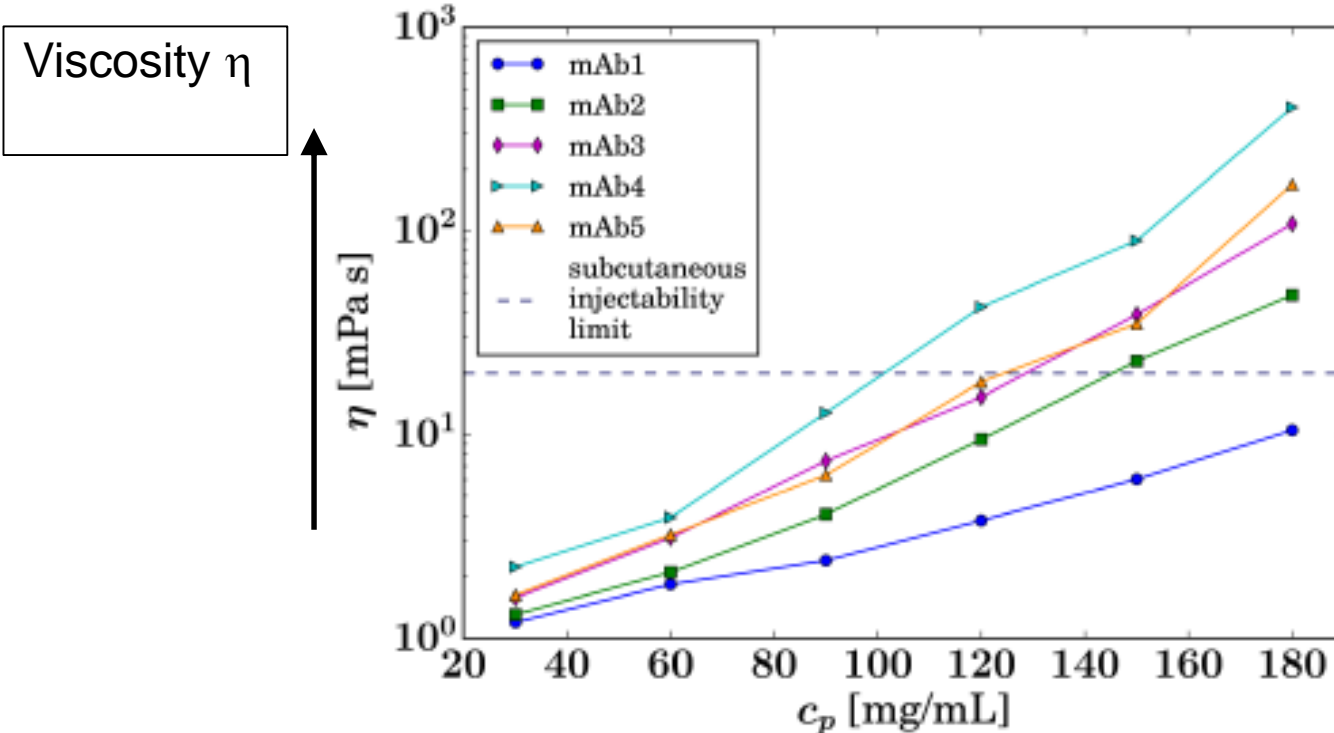
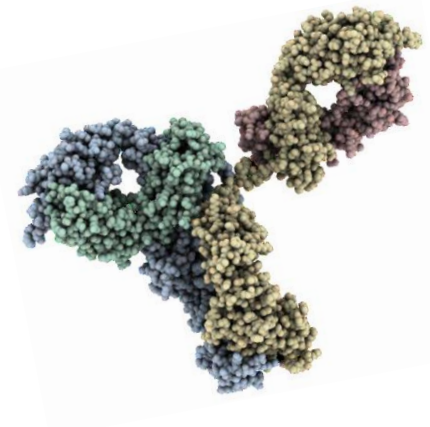


## Organic and Hybrid Thin Films



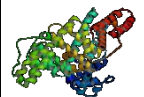
# Protein Dynamics: Macroscopic Viscosity $\eta$

Viscosity  $\eta$  has to stay below threshold for injection !



Diffusion  $D \sim 1 / \eta$   
(Stokes-Einstein)

See also talk 16:15  
by Ilaria Mosca

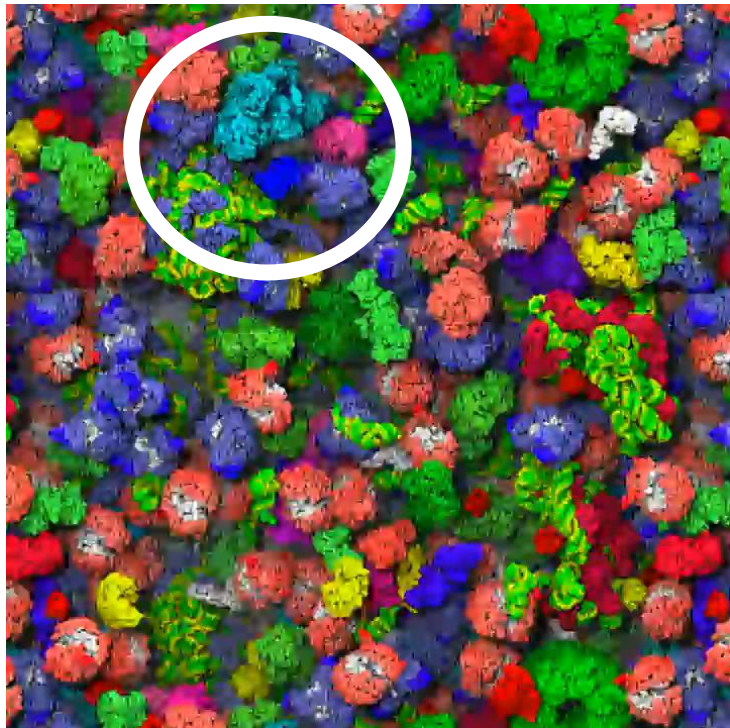
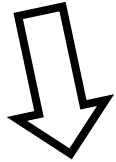




# Protein Dynamics: Crowding

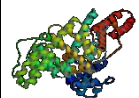
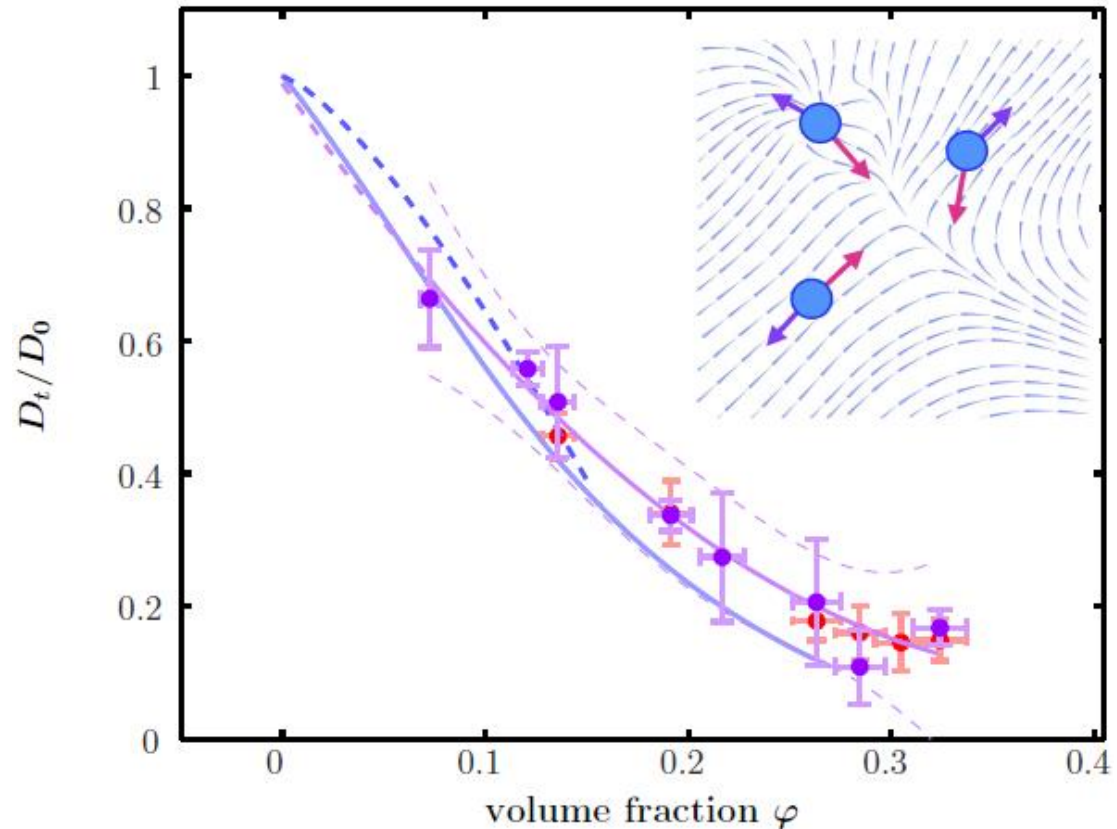
Now targeted deuteration of environment

→ Only proteins of interest visible

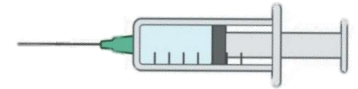
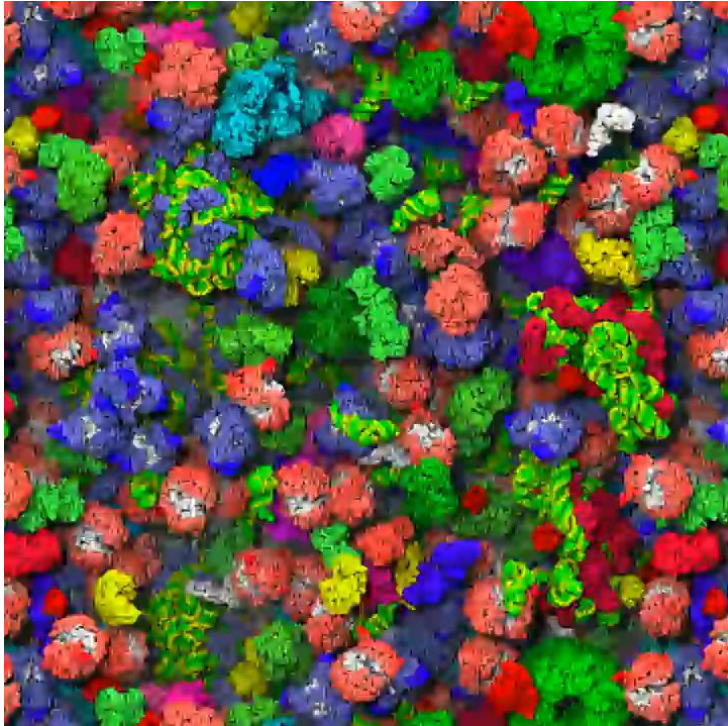


Self-diffusion probed by QENS

- Hydrodynamic interactions important
- 0.3 – 5.0 ns probed are short time diffusion
- no direct interactions
- Slower for higher protein concentration



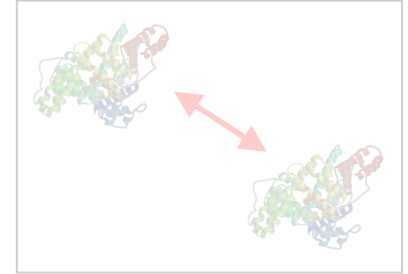
## Protein Biophysics: Bulk / Dynamics



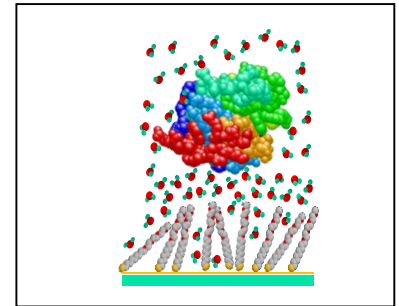
- Protein dynamics (rheology/scattering)  
... collaboration with Grenoble (ILL/PSCM)

# Molecular and Biological Matter

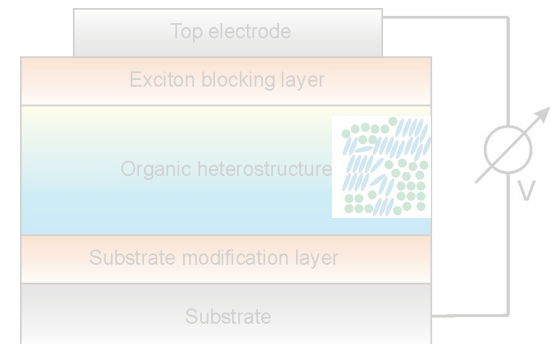
Protein Biophysics: Bulk  
(see Fajun Zhang)



Protein Biophysics: Interfaces

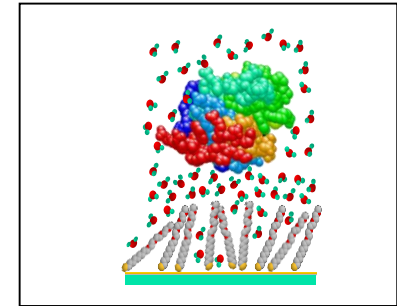
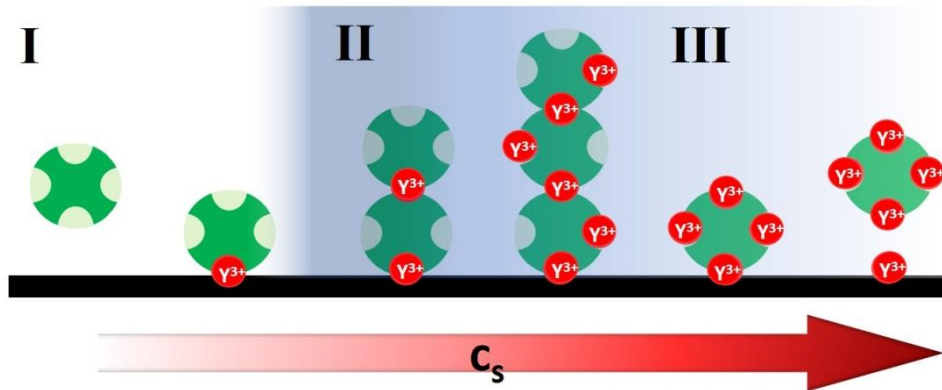


Organic and Hybrid Thin Films



# Protein Biophysics: Interfaces

Controlling protein-interface interactions ?



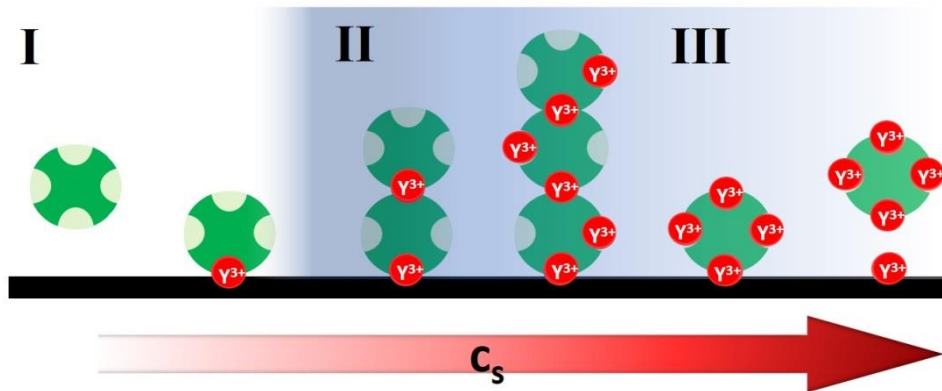
relevance for, e.g.

- biosensors, implants, stents ...
- biotechnology: biofouling, purification, ...
- structural biology: nucleation of crystals ...



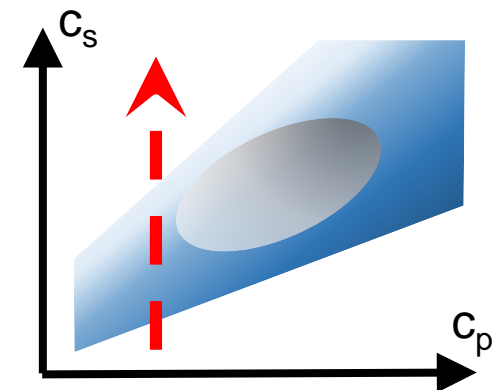
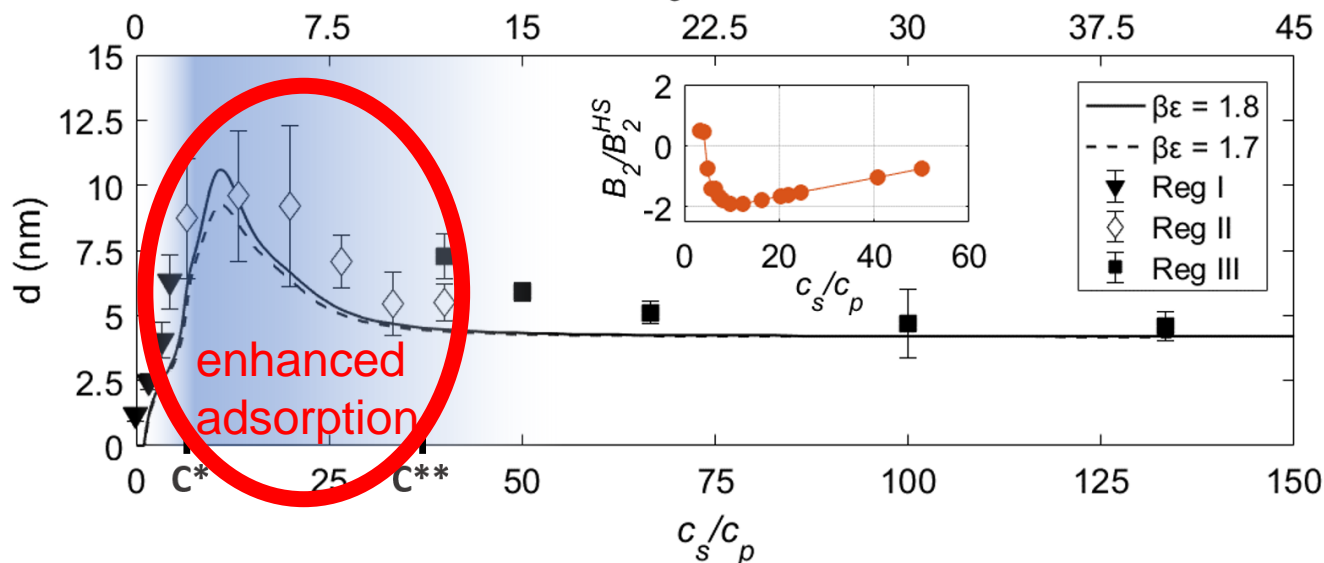
# Protein Biophysics: Interfaces

Controlling protein-interface interactions ?



Interface adsorption

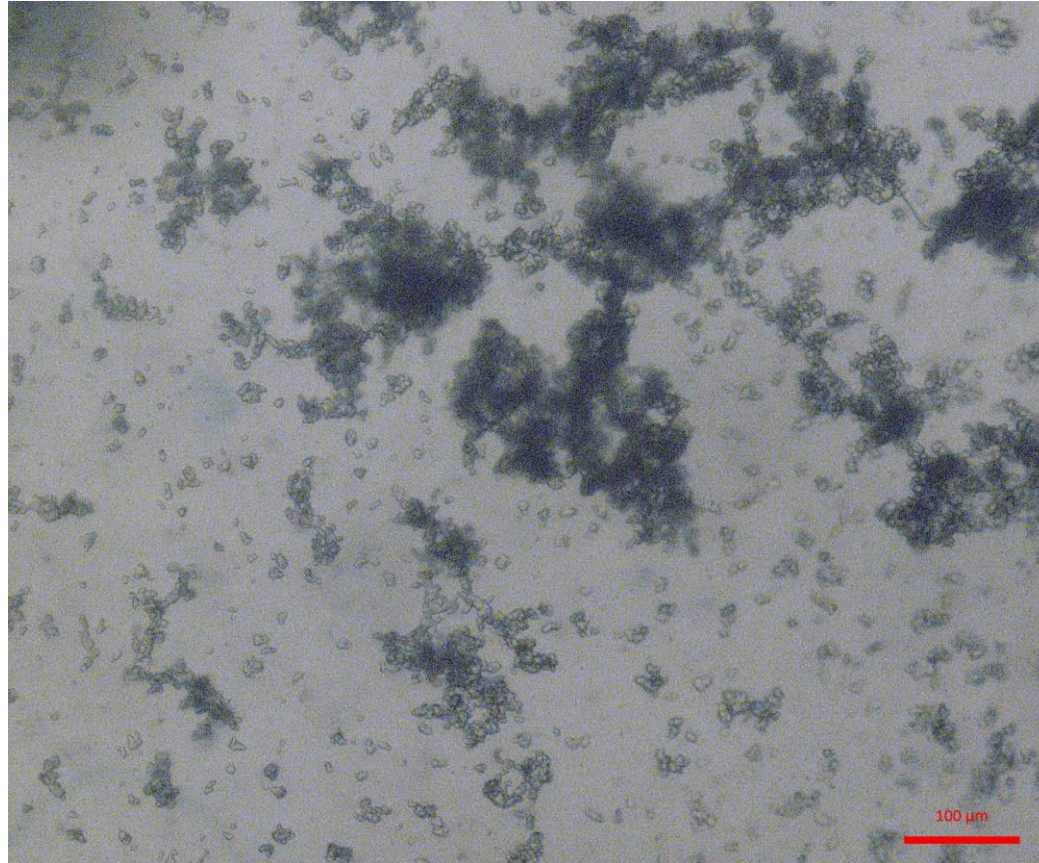
Phase diagram



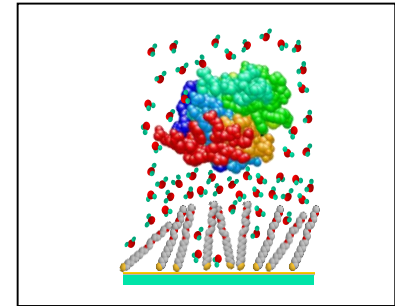
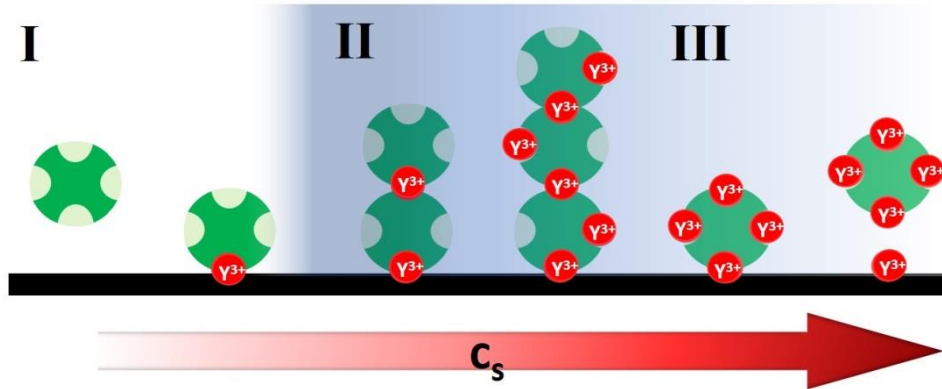
M. Fries et al., Phys. Rev. Lett. (2017)  
M. Fries et al., Nature Sci. Rep. (2020)



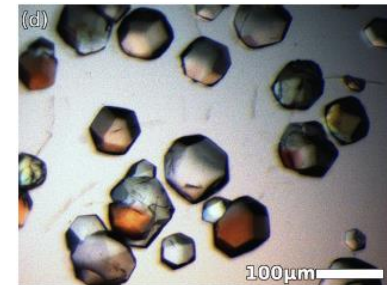
# Protein Crystallisation induced by multivalent ions



## Protein Biophysics: Interfaces

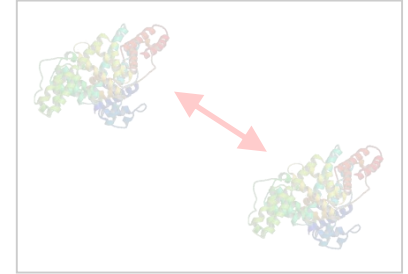


- Interface nucleation of protein crystals
- Tuning adsorption behavior
  - a) Different salt ions
  - b) Surface modifications through coatings
  - c) Electrochemical potential

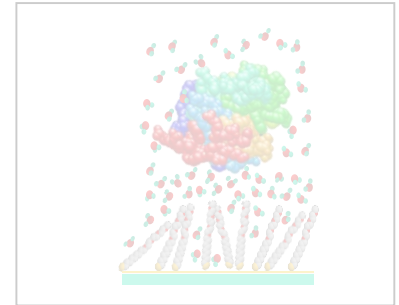


# Molecular and Biological Matter

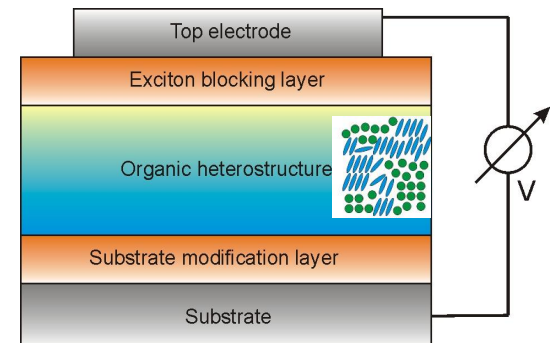
Protein Biophysics: Bulk  
(see Fajun Zhang)



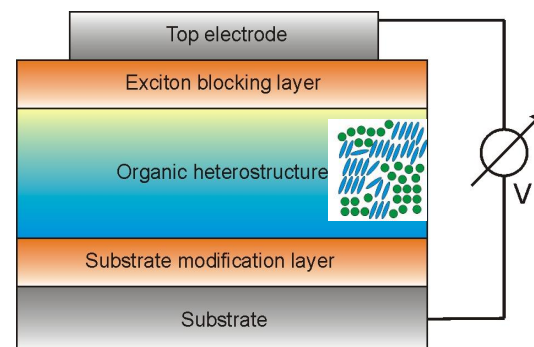
Protein Biophysics: Interfaces



Organic and Hybrid Thin Films

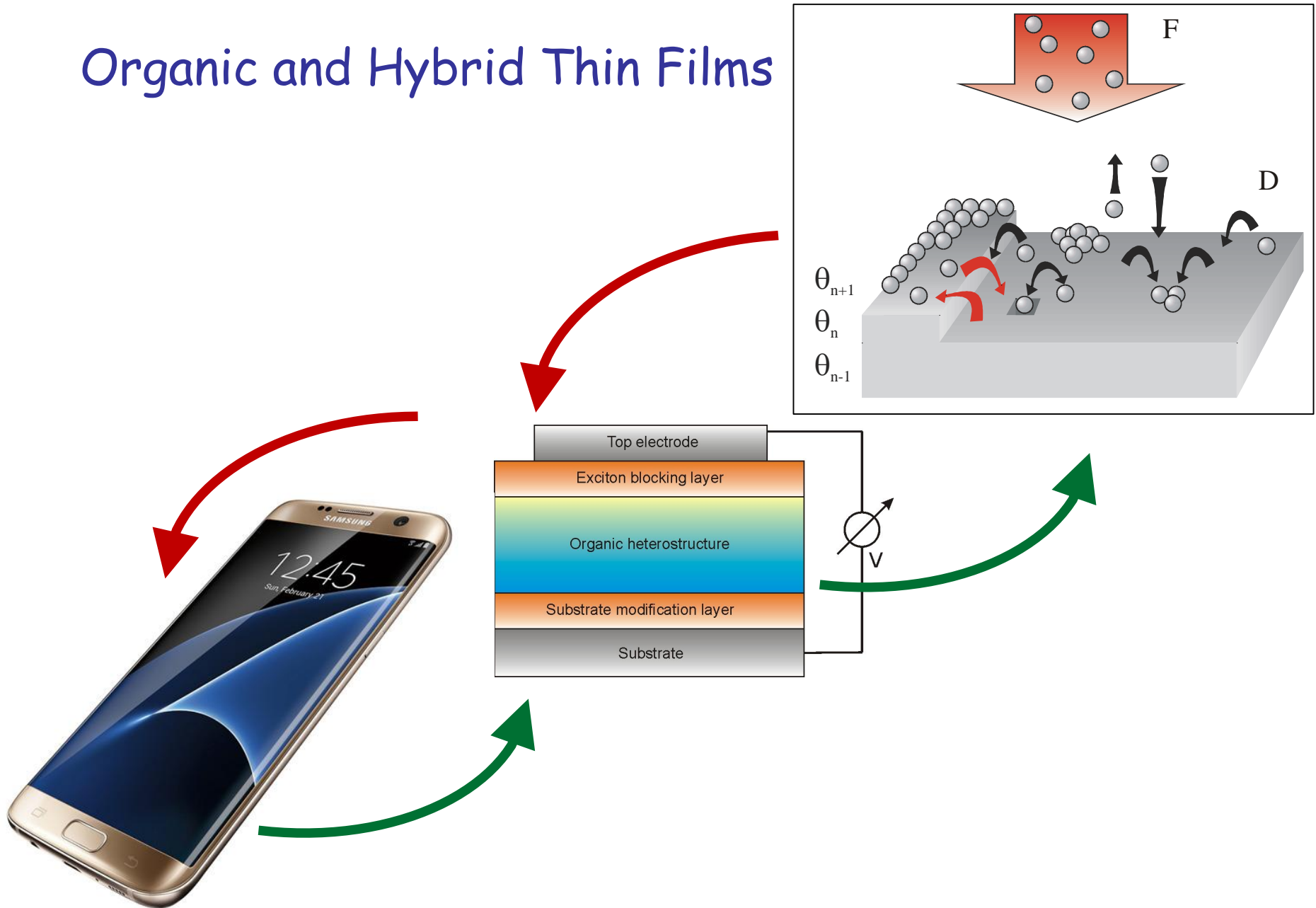


# Organic and Hybrid Thin Films





# Organic and Hybrid Thin Films

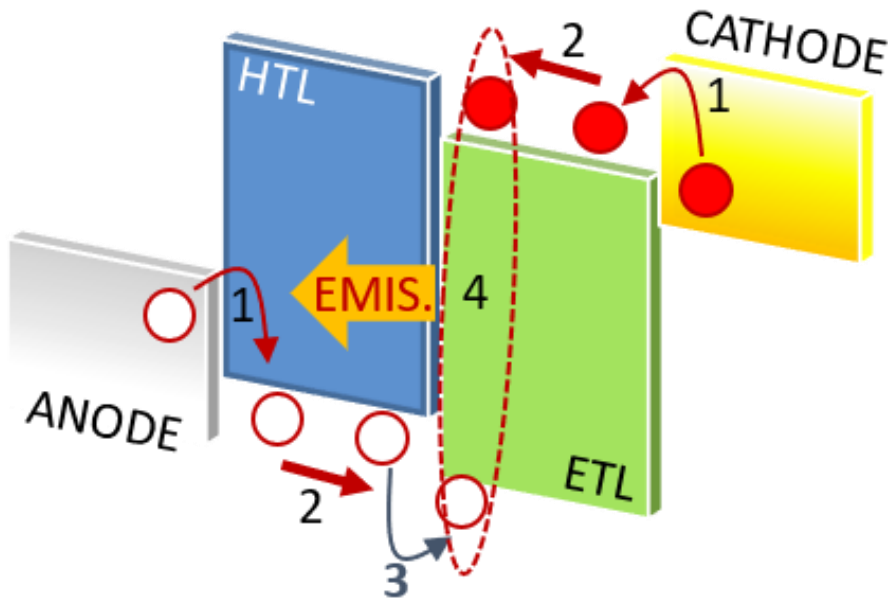


# Organic and Hybrid Thin Films: Donor-Acceptor Structures

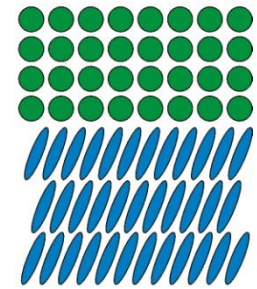
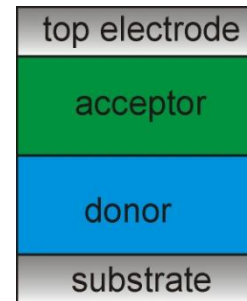
Similar concepts

→ for organic LEDs

→ for photovoltaics (“reverse LED”)

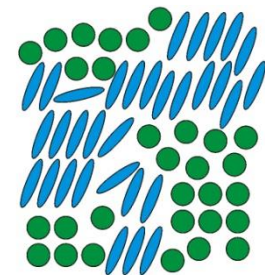
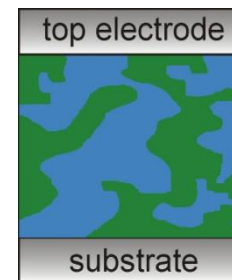


## Planar Heterostructure (PHJ)



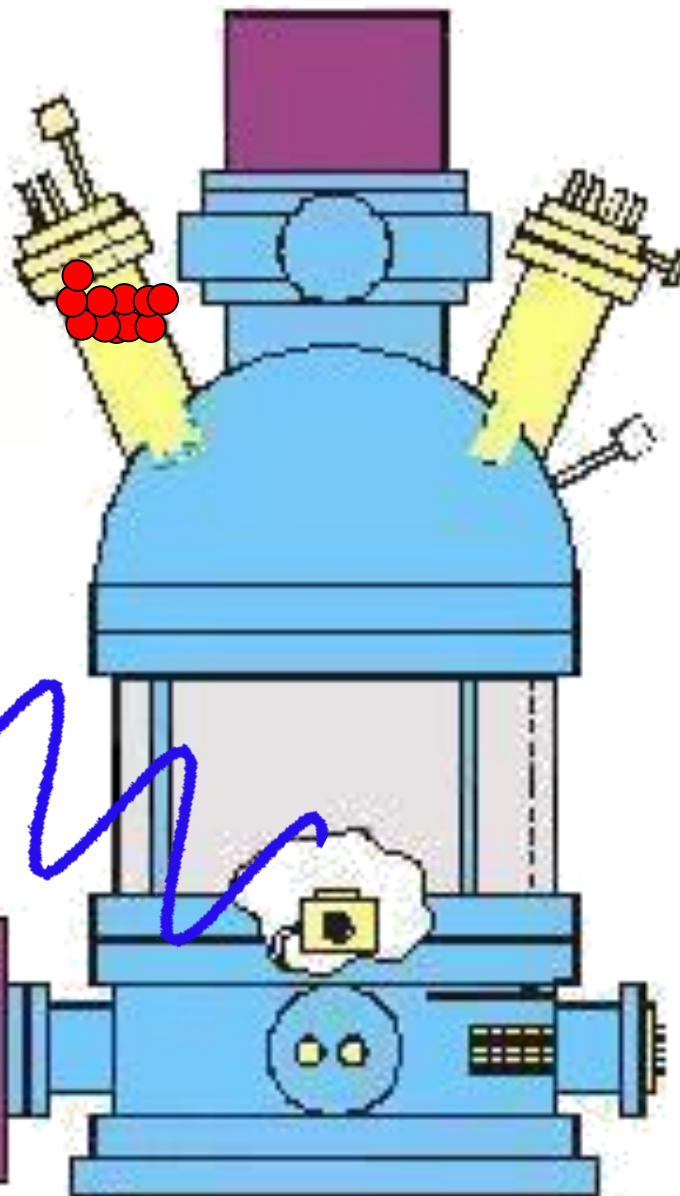
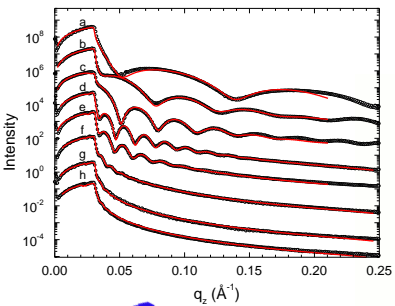
- high charge carrier mobility
- weak exciton dissociation

## Mixed Heterostructure (BHJ)



- low charge carrier mobility
- strong exciton dissociation

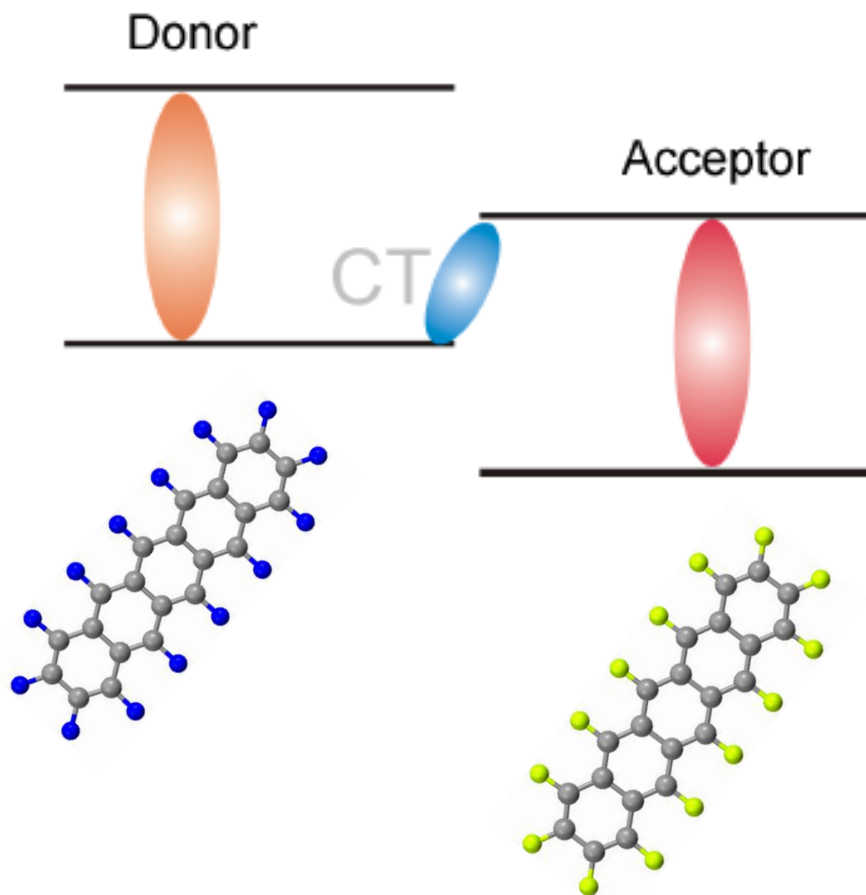
# Real-Time Growth



- out-of-plane structure
- in-plane structure



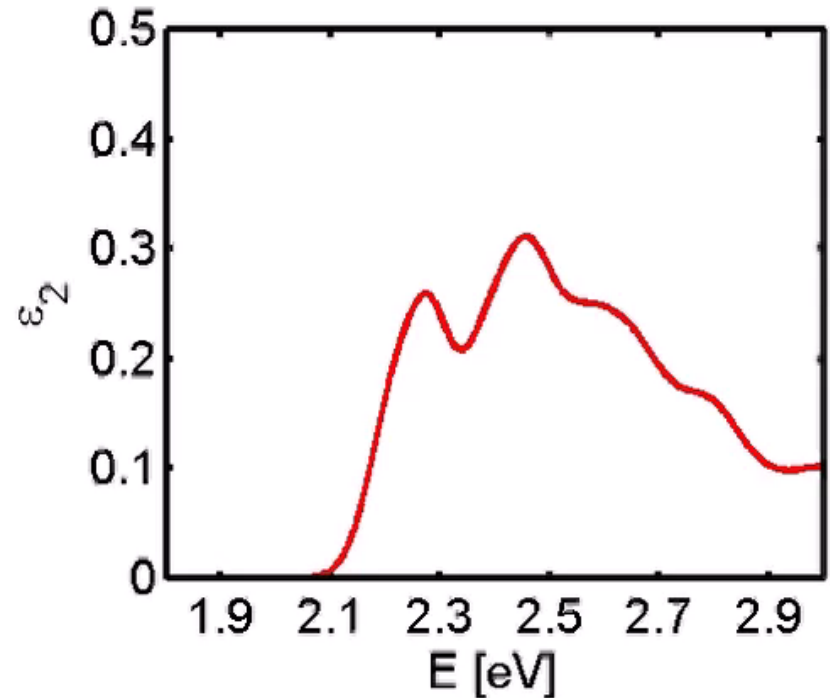
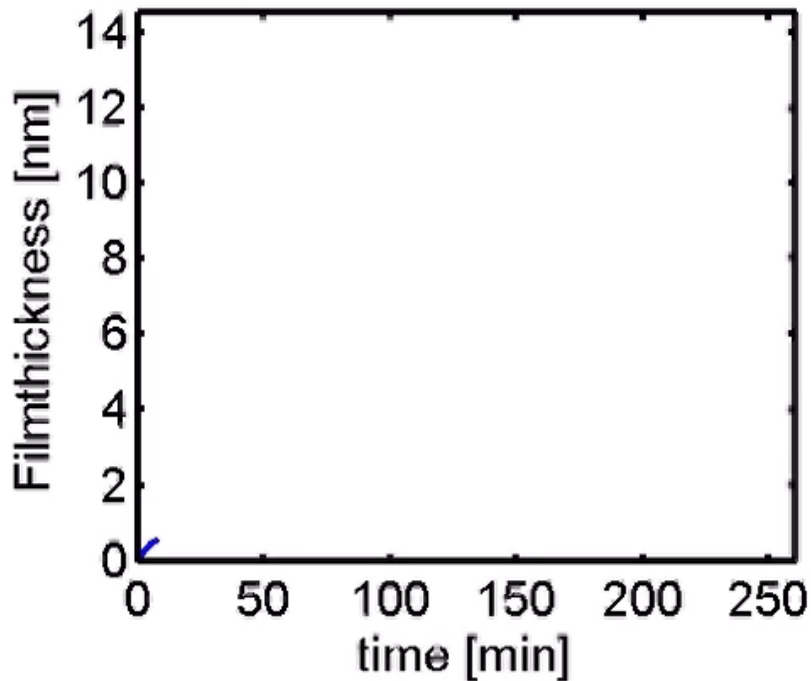
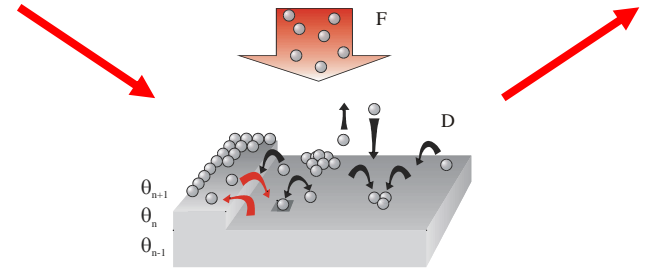
# Charge Transfer Effects in Donor-Acceptor Mixtures





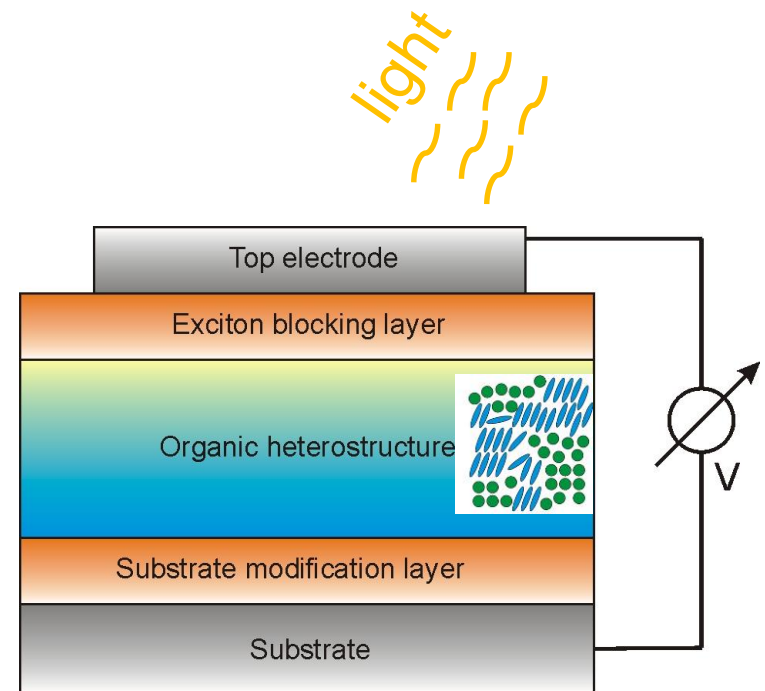
# Optical Properties During Growth

using differential reflectance spectroscopy (DRS)  
and spectroscopic ellipsometry with CCD detection



## Organic and Hybrid Thin Films

- Photoluminescence of donor-acceptor mixtures as a function of temperature
- Hybrid materials (OSCs with Perovskites) optimization of spin coater for in-situ X-ray scattering



## Protein Biophysics: Bulk / Dynamics

- Protein dynamics (rheology and scattering in Grenoble)

## Protein Biophysics: Interfaces

- Interface nucleation of protein crystals
- Tuning adsorption behavior

## Organic and Hybrid Thin Films

- Photoluminescence of donor-acceptor mixtures
- Hybrid materials (OSCs with Perovskites)

## Machine Learning / Data Analysis

- ML for X-ray analysis of thin films

