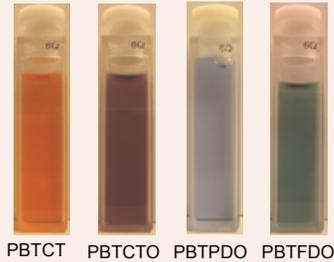


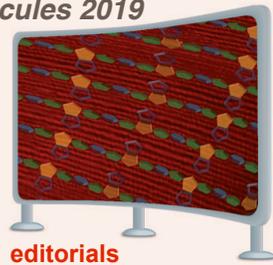
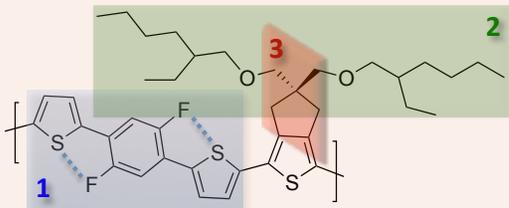
## Molecular Design for Plastic Electronics

Liquid Crystalline CPs  
Field Effect Transistor  
Thermoelectric Polymers

*Nat. Mater.* 2013  
*Chemical Sci.* 2015  
*Adv. Mater.* 2016  
*Macromolecules* 2019



PBTCT PBTCTO PBTPDO PBTFTO

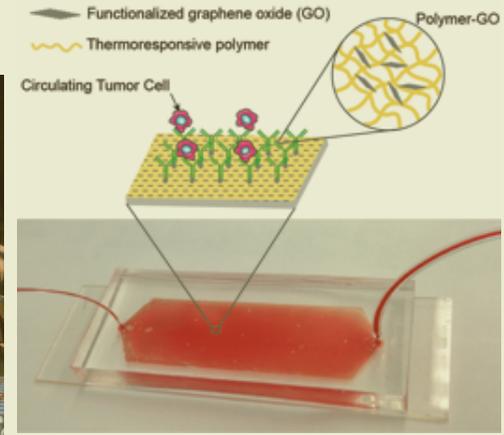


editorials  
NATURE MATERIALS

## Optical Chemical & Biosensors

Circulating Tumor Cell Detection  
Platelet Activation Monitoring  
miRNA Detection

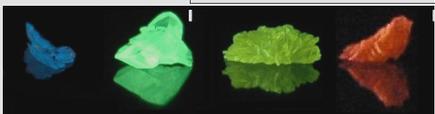
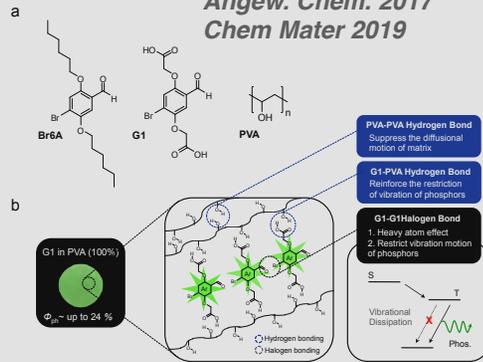
*Chemical Sci* 2016  
*Adv. Mater.* 2016



## Organic Light Emitters

Organic Phosphors  
LED, Sensors,  
Solid-state Lighting,

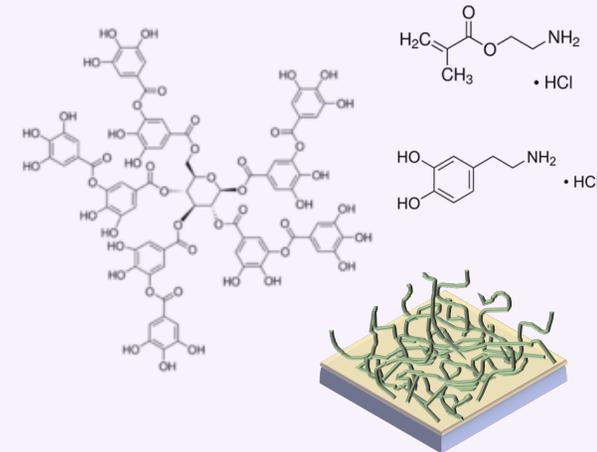
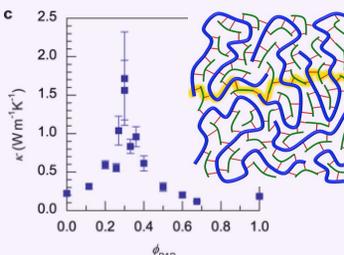
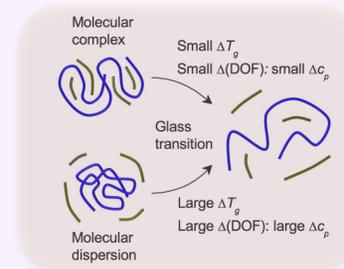
*Nat. Chem.* 2011  
*J. Am. Chem. Soc.* 2013  
*Angew. Chem.* 2014  
*Chem. Mater.* 2014  
*Nat. Commun.* 2015  
*Angew. Chem.* 2017  
*Chem Mater* 2019



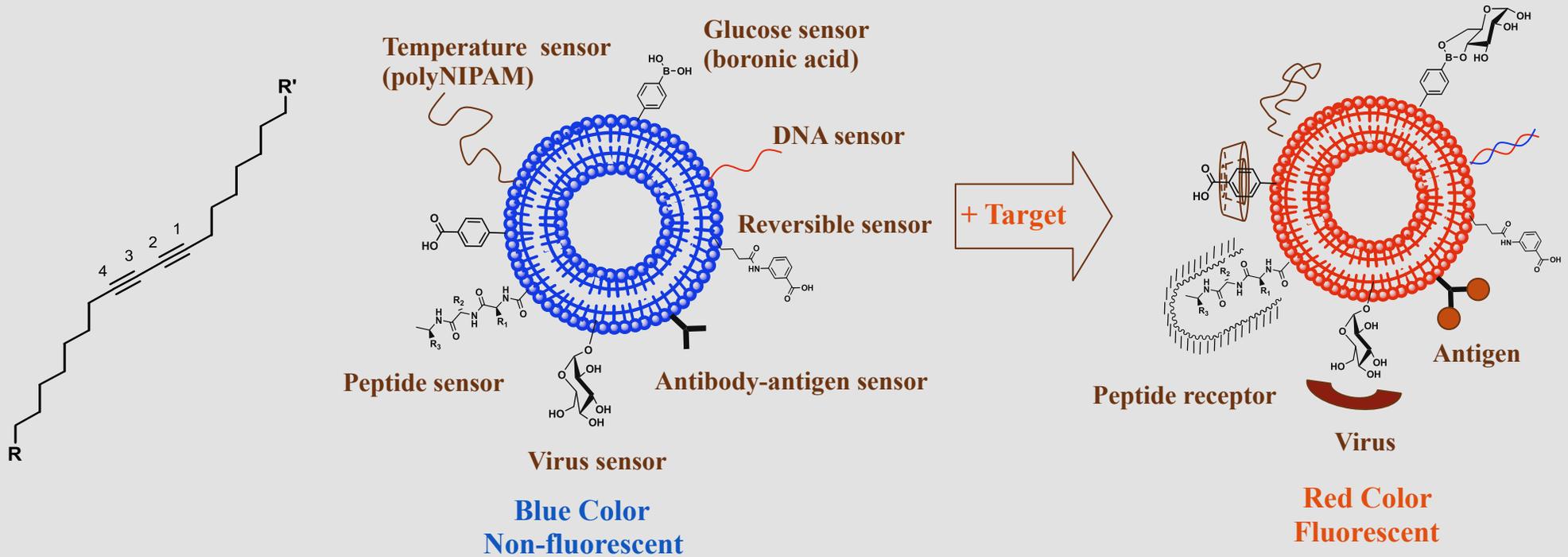
## Designer Functional Organic and Polymer

Heat Management in Polymers  
Biomimetic Adhesives and  
Surface Functionalization

*Nature Materials* 2015  
*ACS Central Sci.* 2015  
*Science Advances* 2017

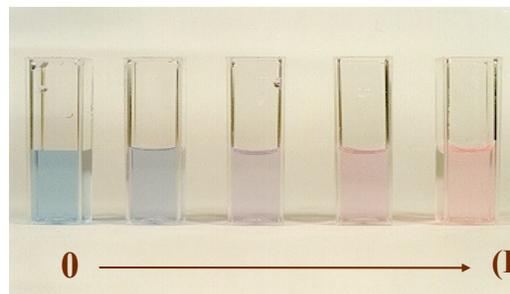
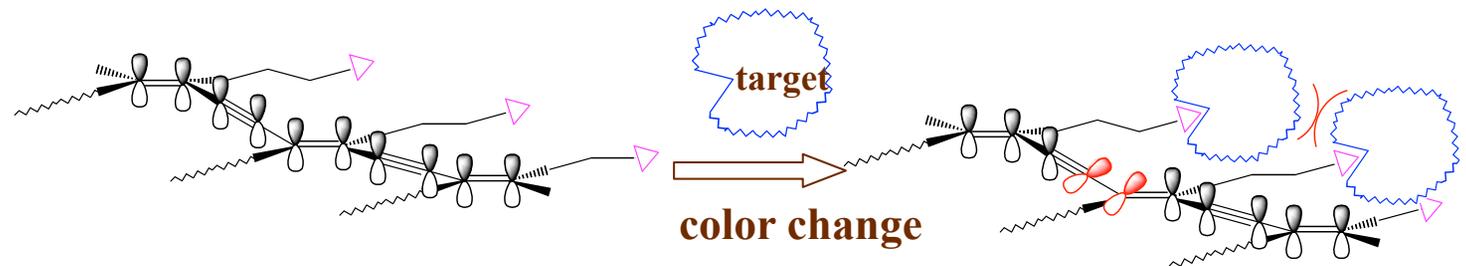


# Application of Polydiacetylene Sensors

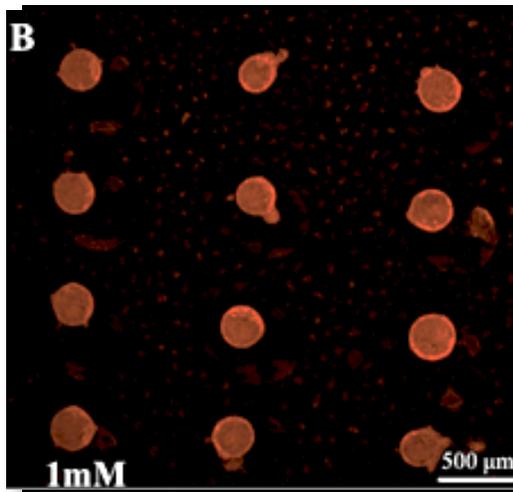
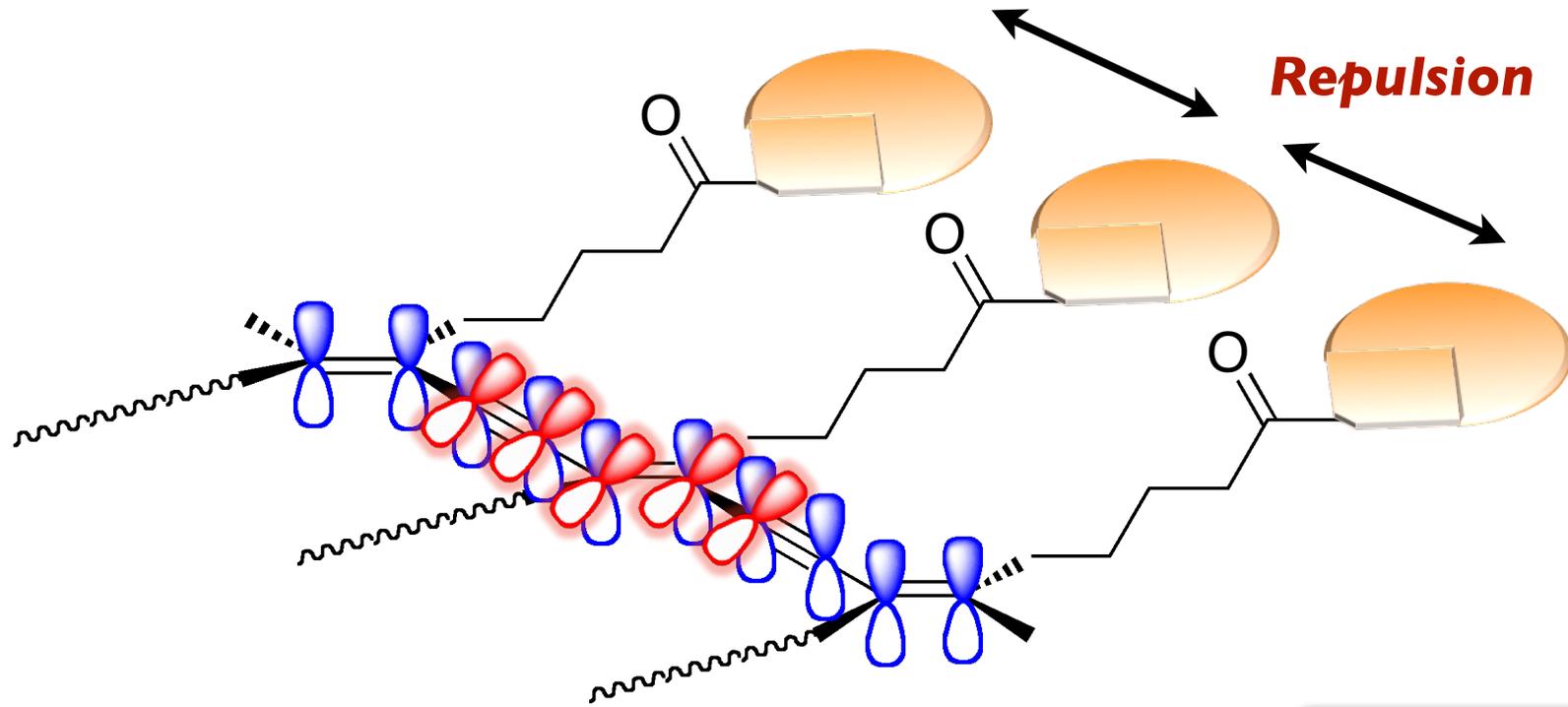


## Developed Sensors

- Nerve Agents
- Antibiotics
- Melamine
- Proteins
- Hg<sup>2+</sup>
- Influenza Virus
- Prostate Specific Antigen
- K<sup>+</sup>
- DNA
- Immunofluorescence labeling



# Disrupting pi-conjugation of PDA triggers optical signals



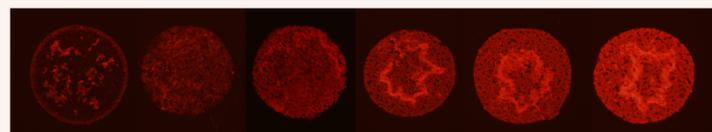
*partially twisted p-orbitals*

Fluorometric & Colorimetric  
Dual Signal

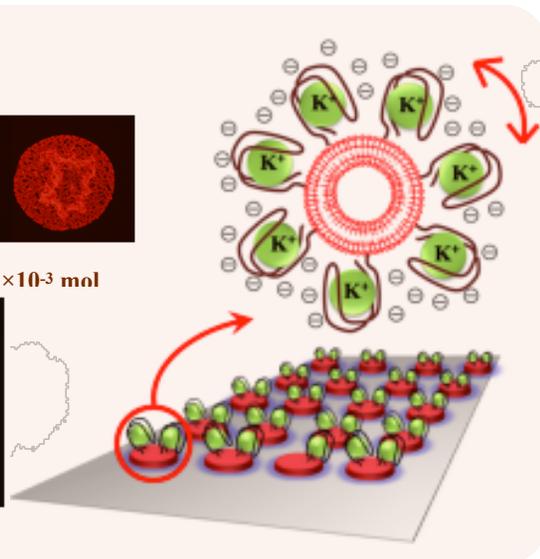
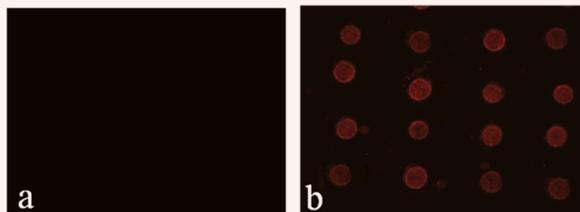


# Self-signaling and Signal-amplifying Optical Sensors

*K<sup>+</sup> Sensor JACS 2008, 130, 5010.*

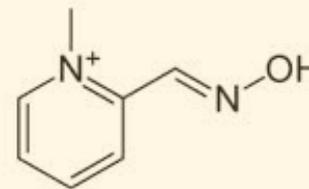


0.01 0.05 0.1 0.25 0.5  $1.0 \times 10^{-3}$  mol

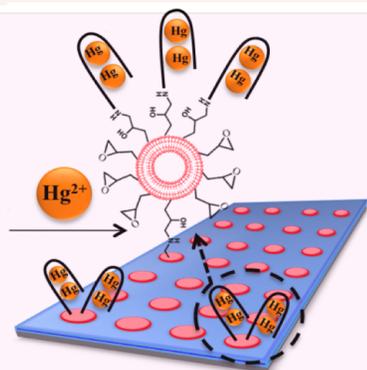
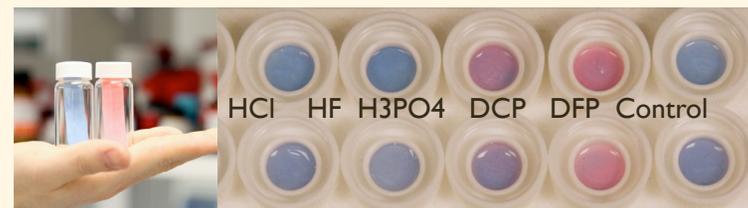


*Nerve gas sensor Adv. Func. Mater. 2010 and 2012.*

## Antidote



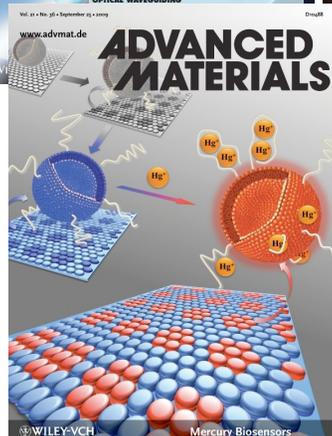
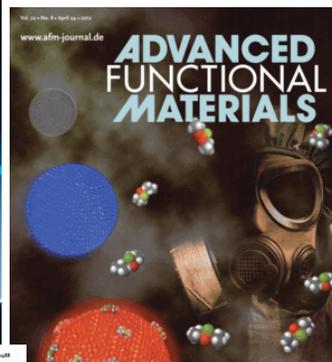
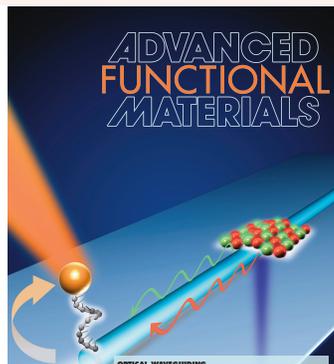
(2-PAM)



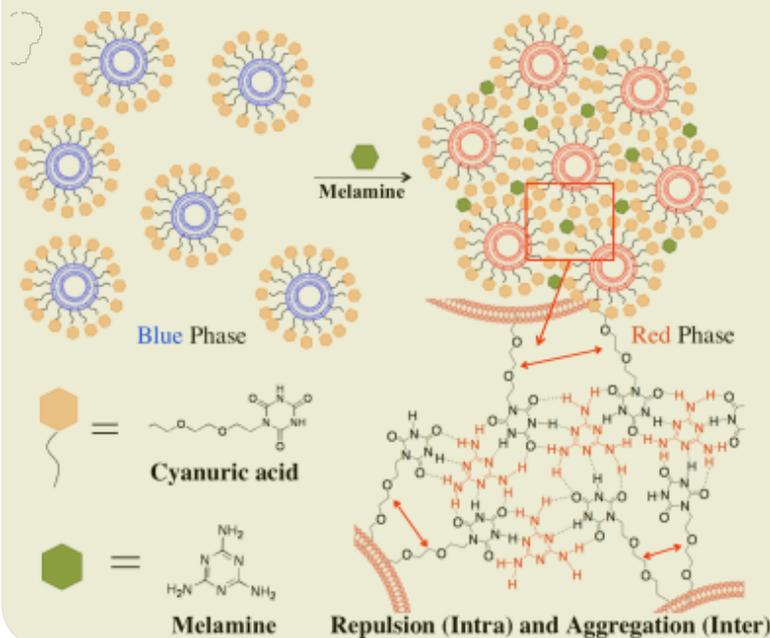
*Mercury Sensor Adv. Mater. 2009, 21, 3674.*

## Developed Sensors

- Nerve Agents
- Bacteria & Influenza Virus A
- Antibiotics
- Melamine
- Prostate Specific Antigen
- DNA
- Mercury
- Potassium
- Water



*Melamine sensor Chem Comm 2010, 47, 358.*



Special Issue: Biosensors  
Guest-edited by B. Z. Tang  
and B. Su

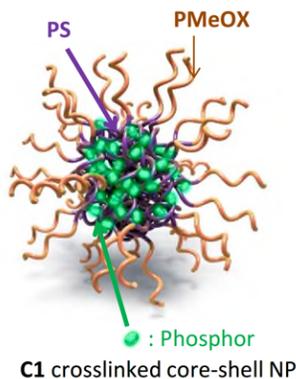
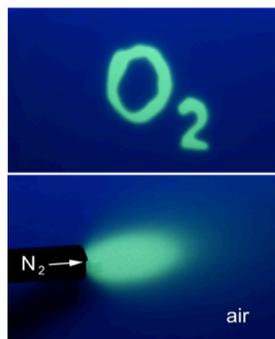
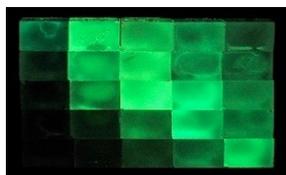
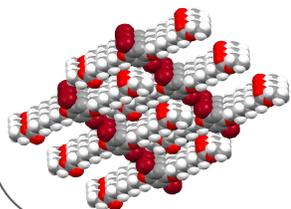
9/2013

WILEY-VCH

# Novel Emissive Materials by Design

## Understanding the Intermolecular Phenomena

- Halogen Bonding
- Crystallography and Photophysics
- Emission Intensity vs. Crystal



## Fundamentals:

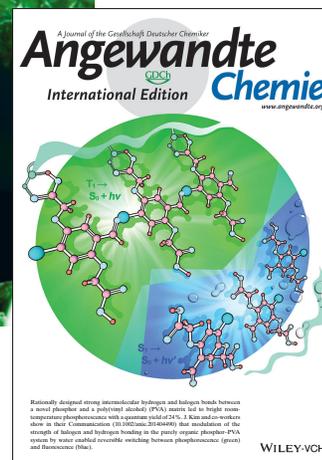
- Materials Chemistry
- Molecular Photophysics
- Device Physics

## Applications:

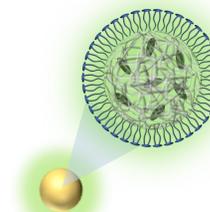
- Solid-state Lighting
- Light Emitting Diodes
- Photovoltaics
- Polarized Emission Devices

## Color Tuning & Conducting Property

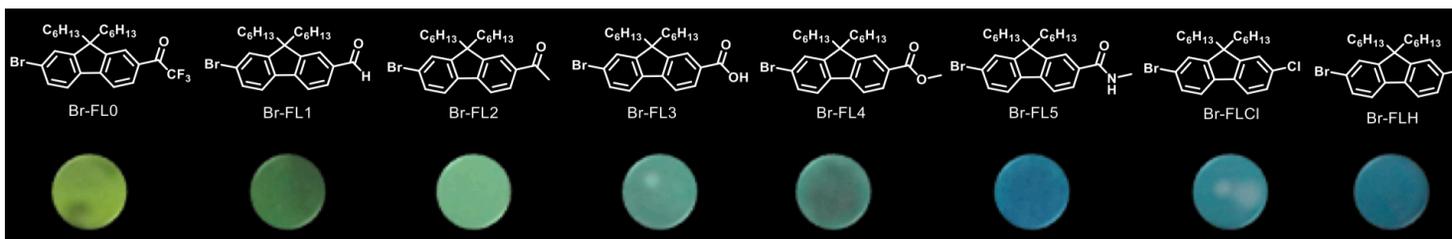
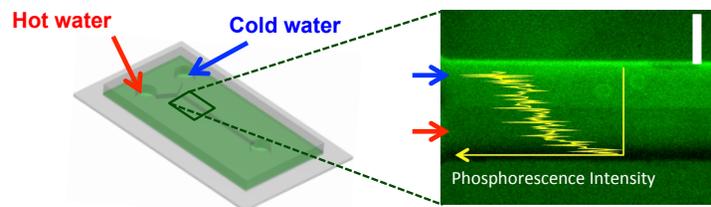
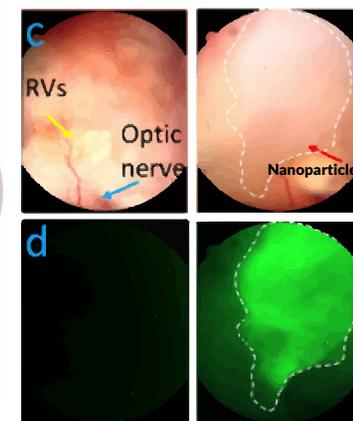
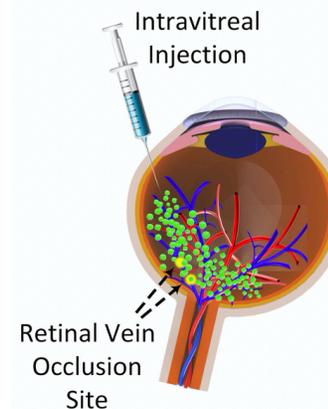
- Electron Density of the Core Unit
- Extended Conjugation in the Core Unit
- Conducting Property



## Argon Air

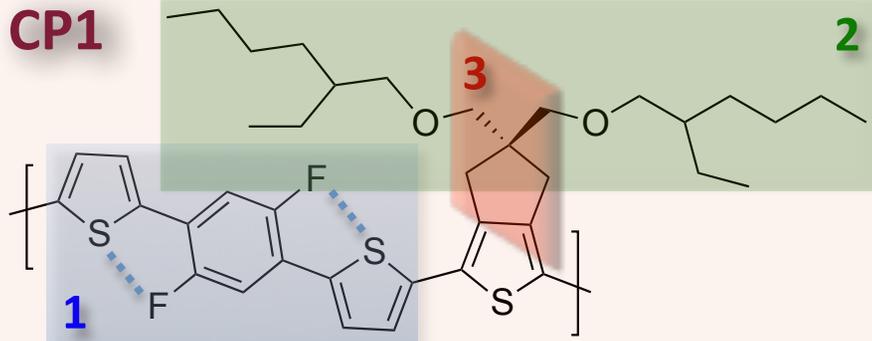


“On”

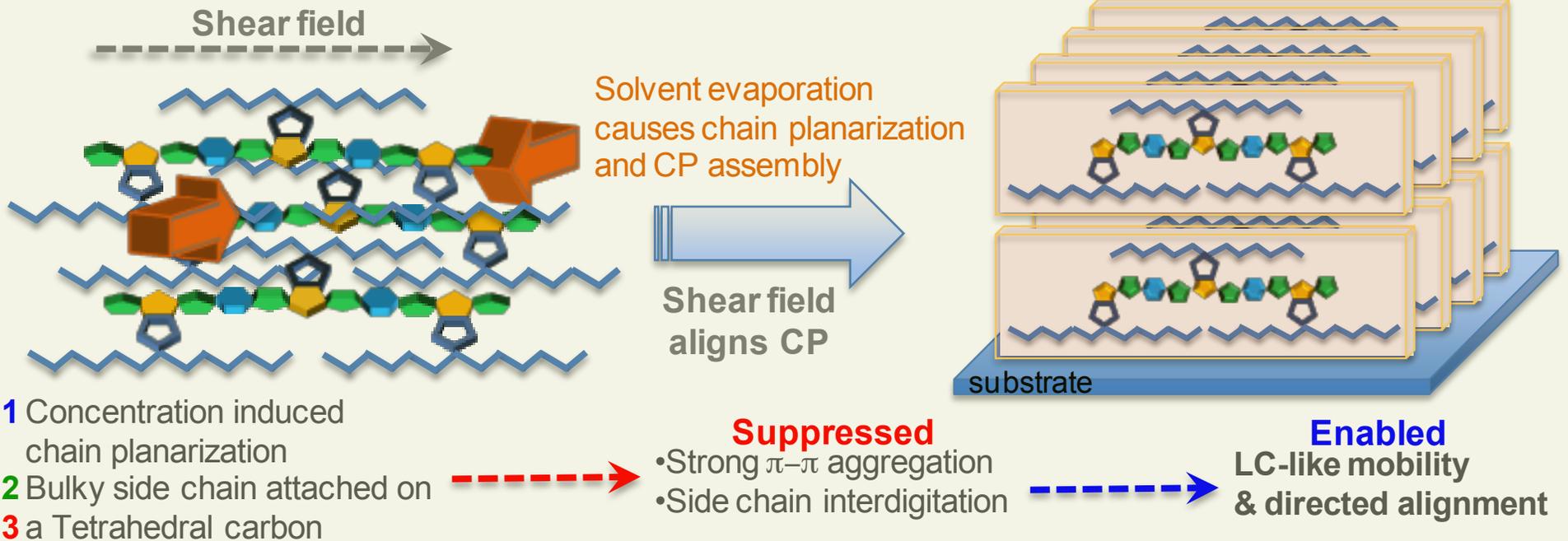


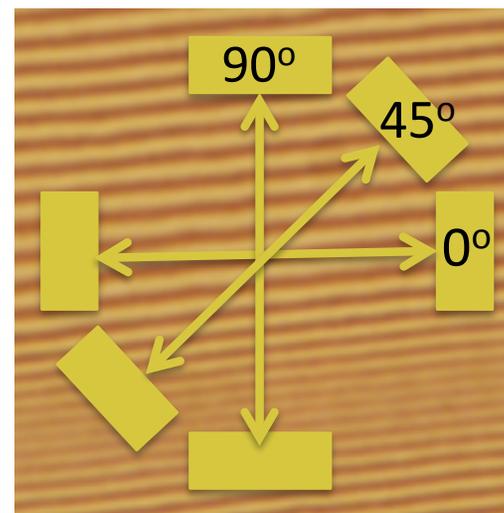
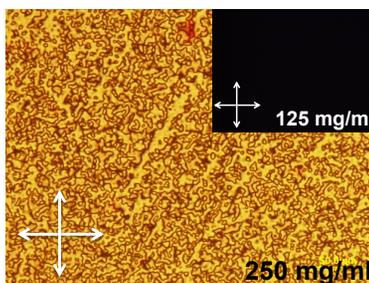
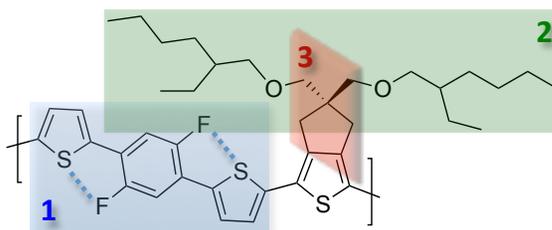
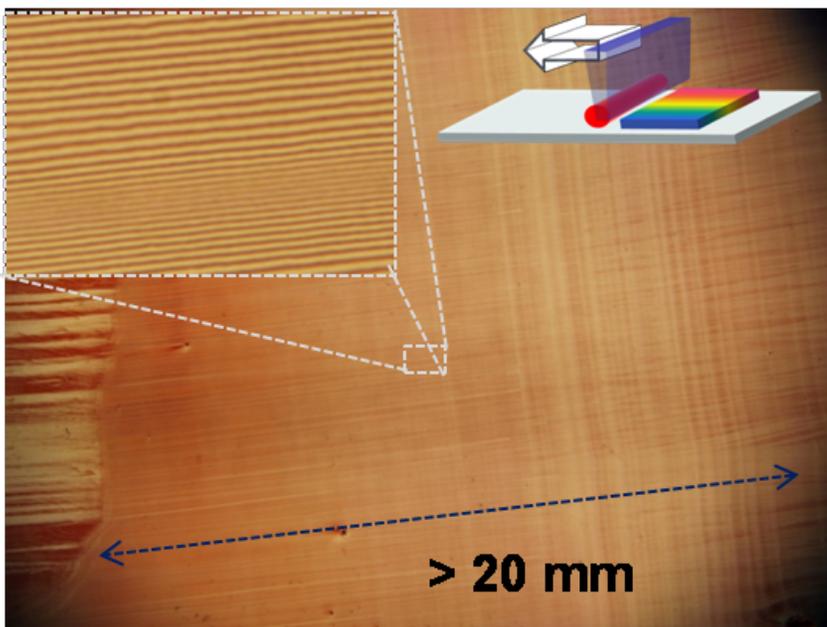
*Nature Chemistry* 2011, 3, 205.  
*J. of Am. Chem. Soc.* 2013, 135, 6325.  
*Angew. Chem. Inter. Ed.* 2014, 53, 11177.  
*Chem. Mater.* 2014, 26, 6644.  
*Nature Communications* 2015, 6, 8947.  
*Angew. Chem. Inter. Ed.* 2017, 56, 16207.

# Lyotropic Liquid Crystalline CP Design for Directed Conjugated Polymer Alignment

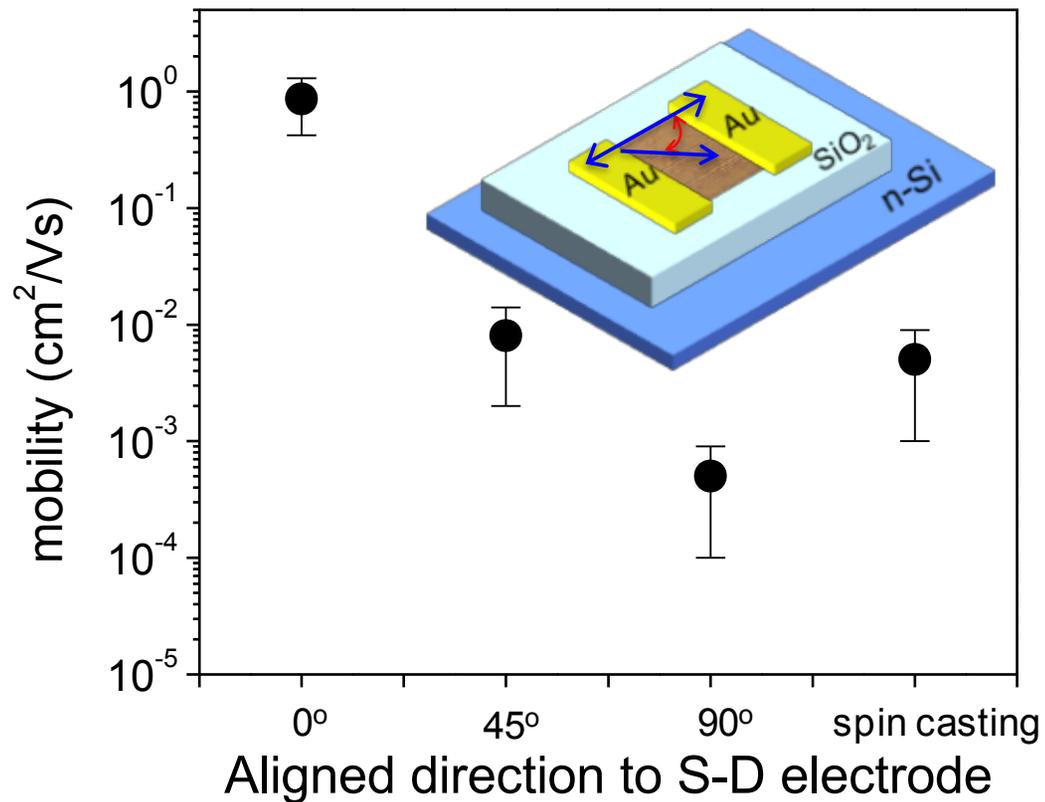
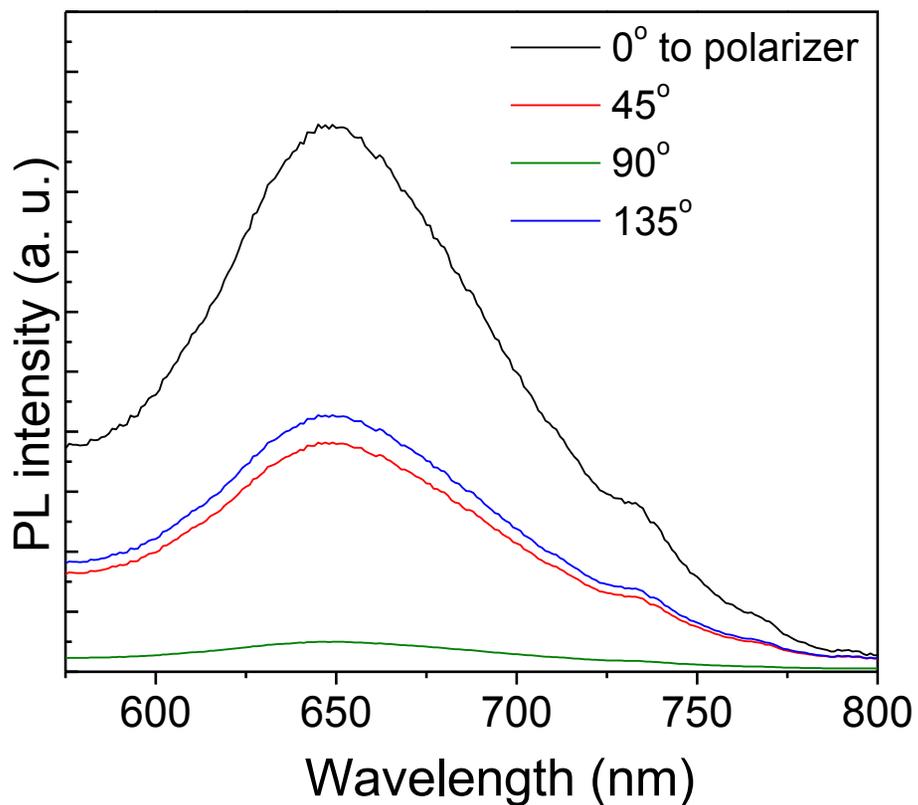


1. Concentration-induced Chain Planarization
2. Non-interdigitating Large Side Chain
3. Out-of-plane Tetrahedral Carbon Linker



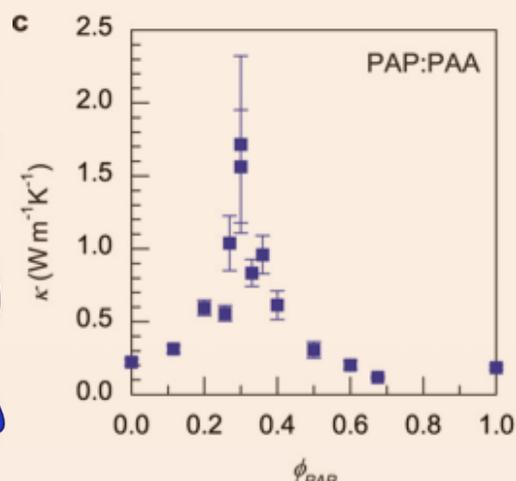
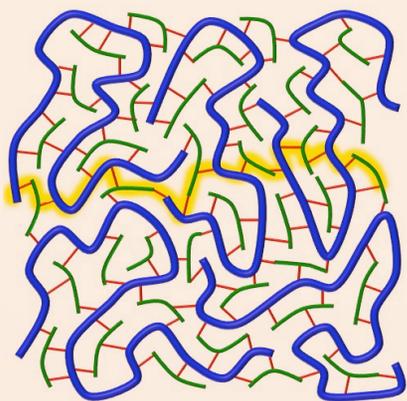
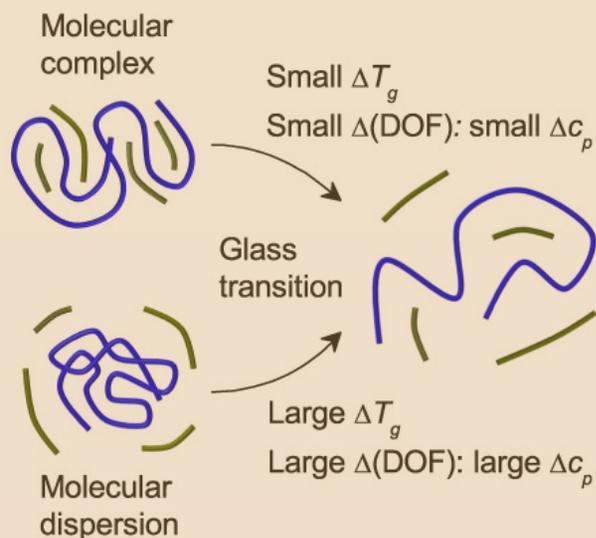


## Hole mobility by TFT



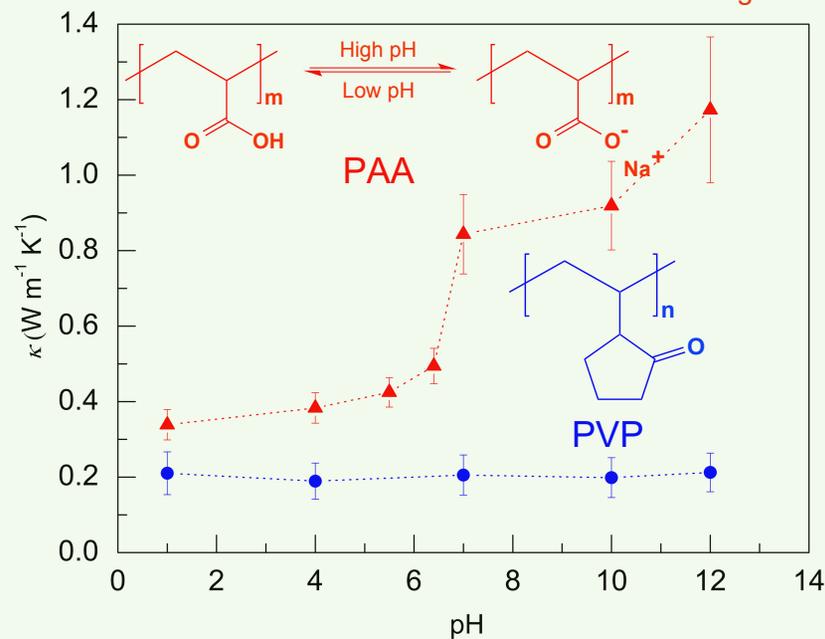
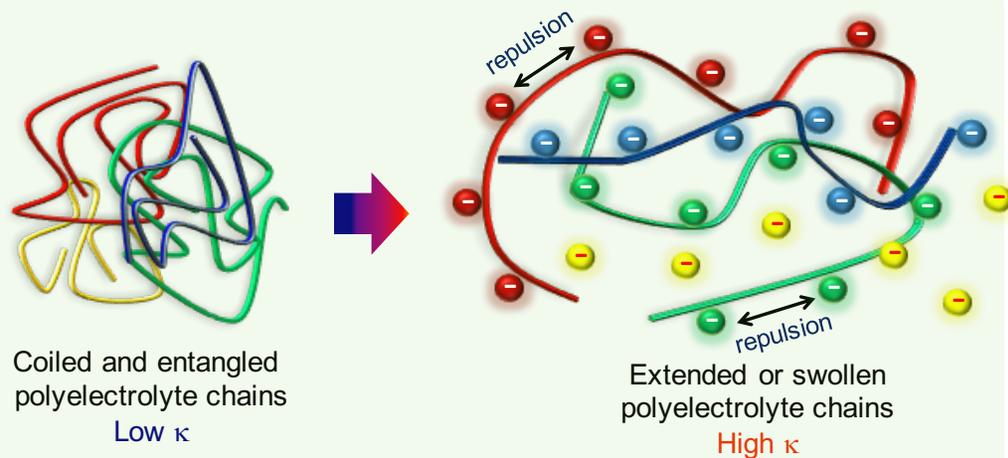
# High Thermal Conductivity in Amorphous Polymers

## Polymer Blend System



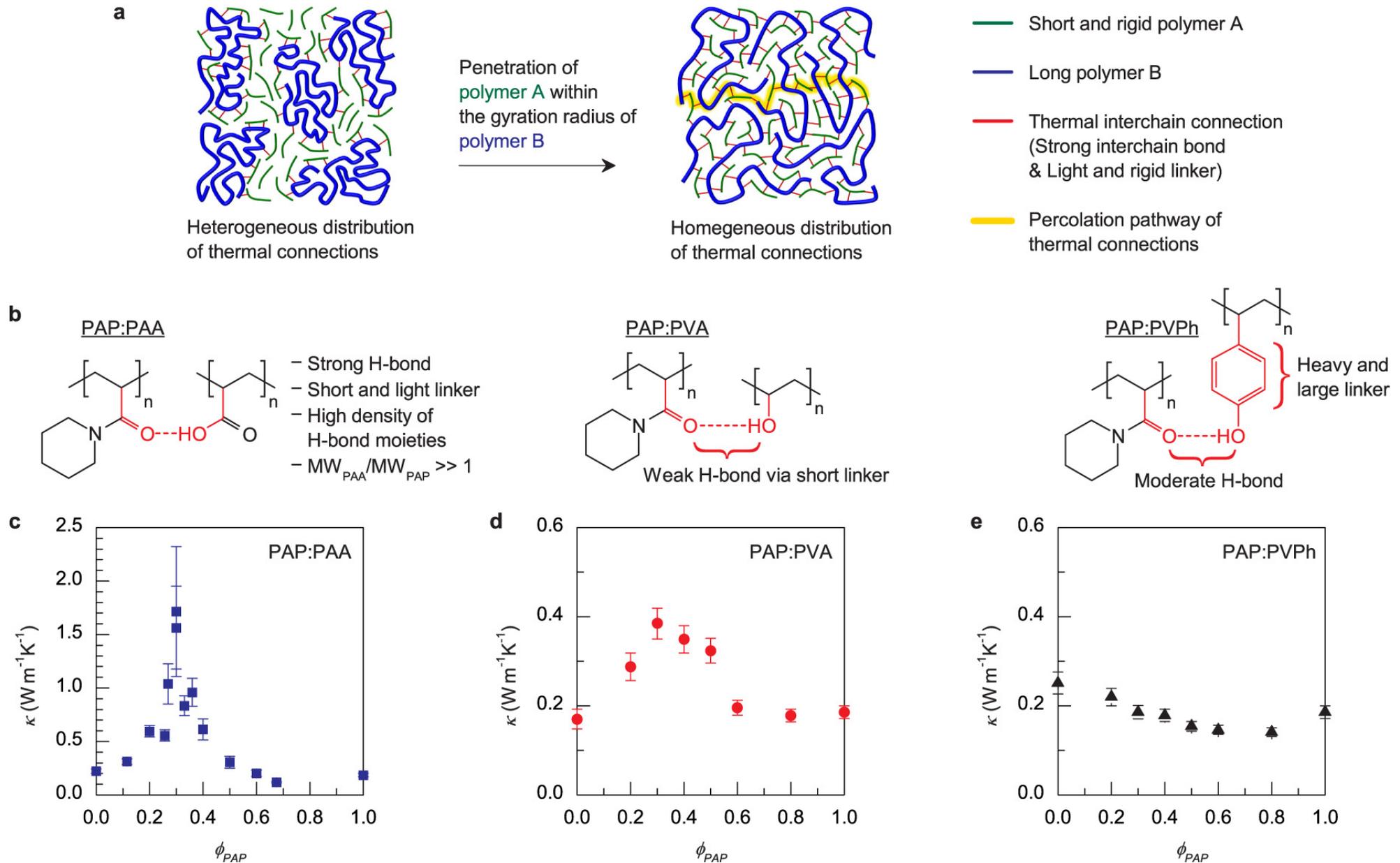
Gun-Ho Kim<sup>+</sup>, Dongwook Lee<sup>+</sup>, Apoorv Shanker<sup>+</sup> *et al*  
**Nature Materials** 2015, 14, 295.

## Polyelectrolyte System

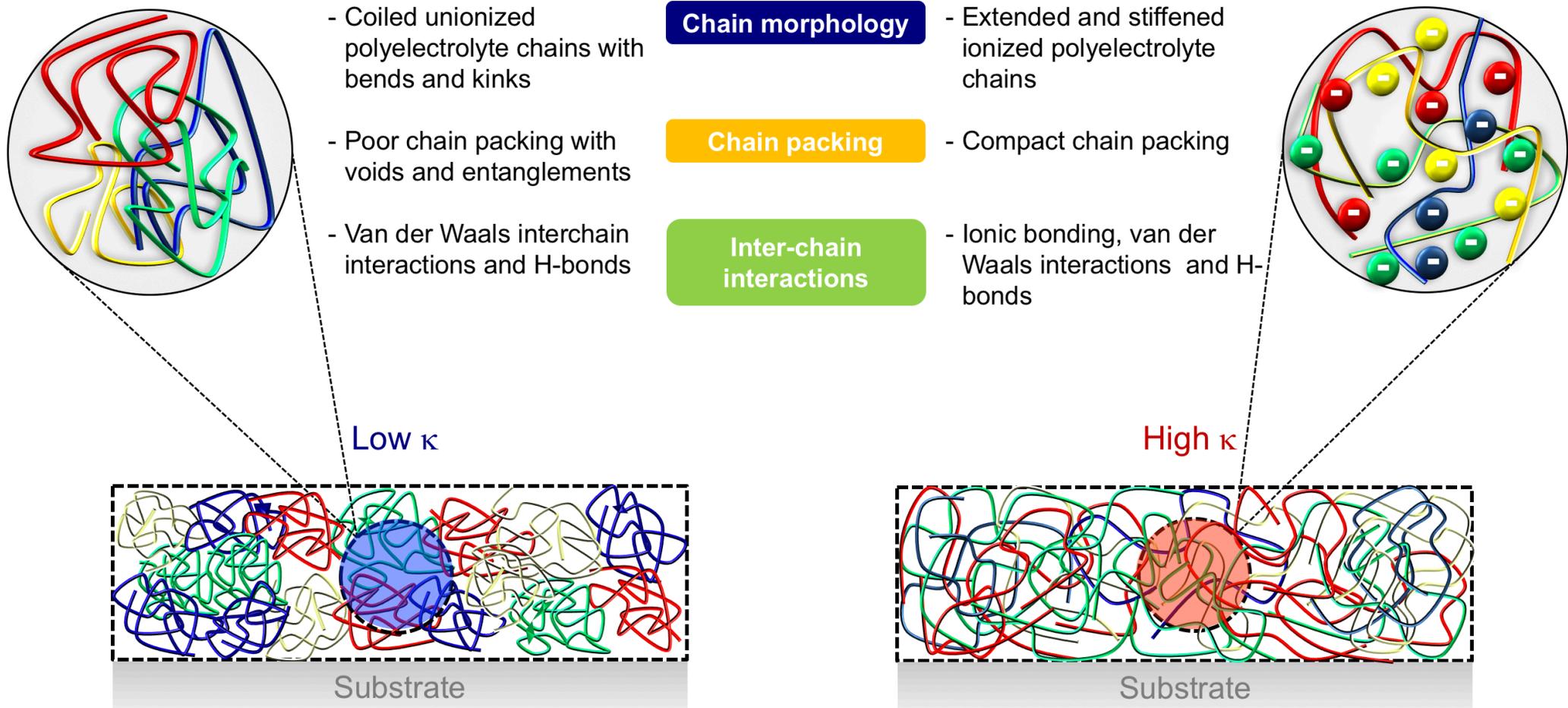


Apoorv Shanker<sup>+</sup>, Chen Li<sup>+</sup> *et al*  
**Science Advances** 2017, 3, 1700342.

# 1. Through Interpolymer Bonding



## 2. Electrostatically Induced Random Chain Extension



Apporv Shanker<sup>+</sup>, Chen Li<sup>+</sup>, Gun-Ho Kim, David Gidley, Kevin Pipe<sup>\*</sup>, Jinsang Kim<sup>\*</sup> "Electrostatically induced random chain extension for high thermal conductivity in amorphous polymers" *Science Advances* 2017, 3, 1700342.