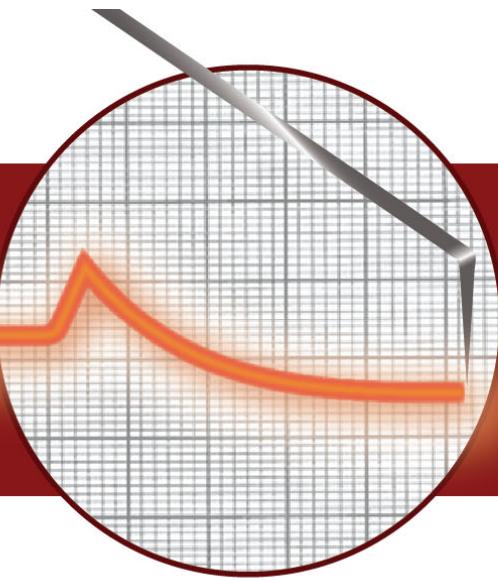


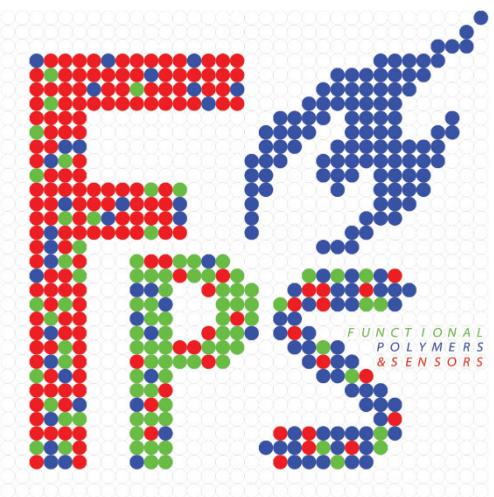
Imaging makes everything better

Credit: Event Horizon Telescope collaboration

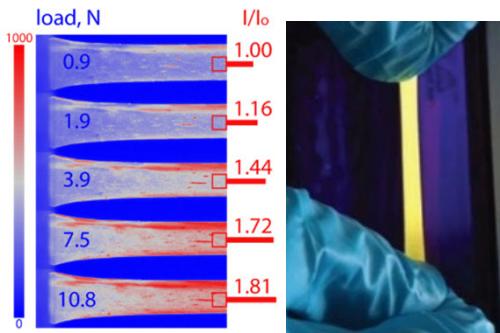


Molecular mechanochemistry for optical imaging in polymer films

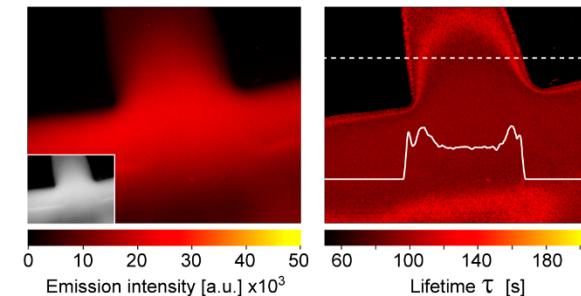
Georgy Filonenko



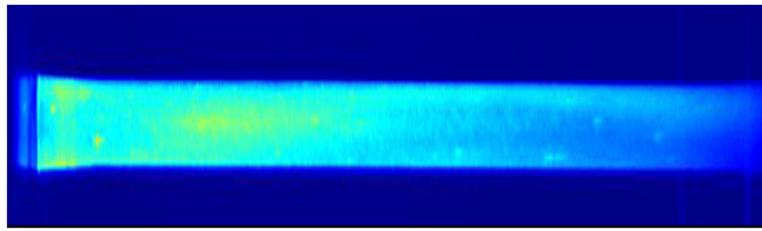
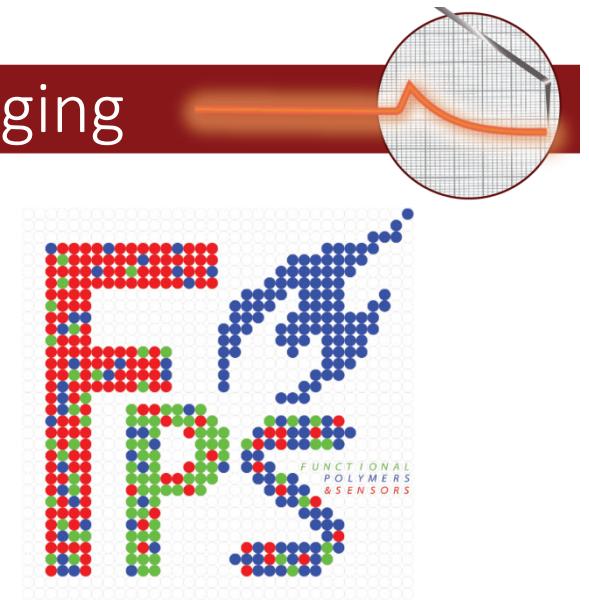
Imaging for materials and materials for imaging



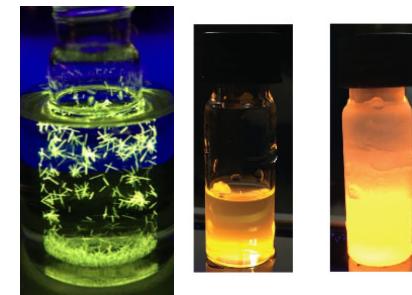
Fracture and mechanics



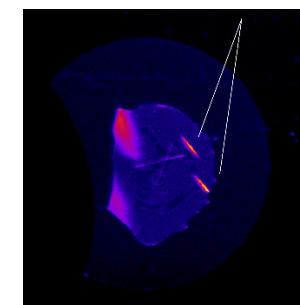
Prototyping & Defect imaging



Real time stress imaging



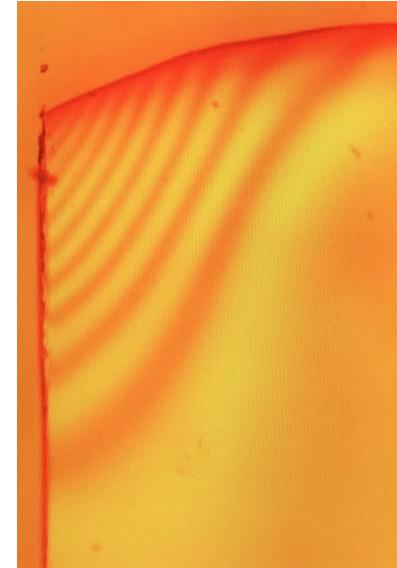
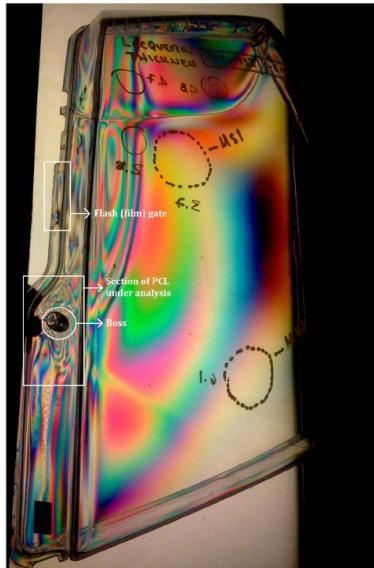
Molecular sensing



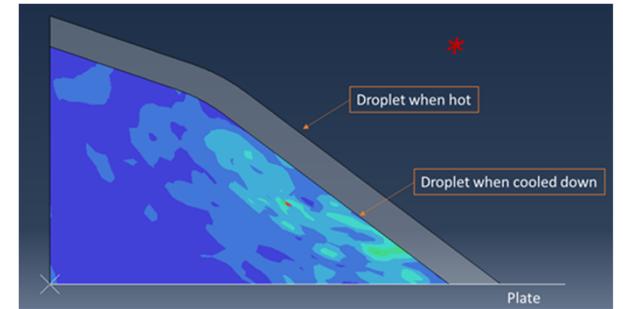
Shock & Friction



Films and stresses



Due to the high aspect ratio



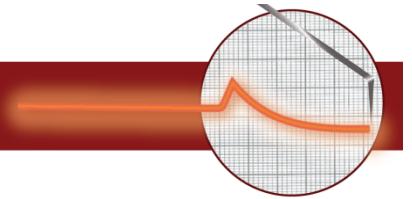
Macroscopic L-S transition

Very dramatic in films

* Credit: Vinay Damodaran @Shaping_Matter

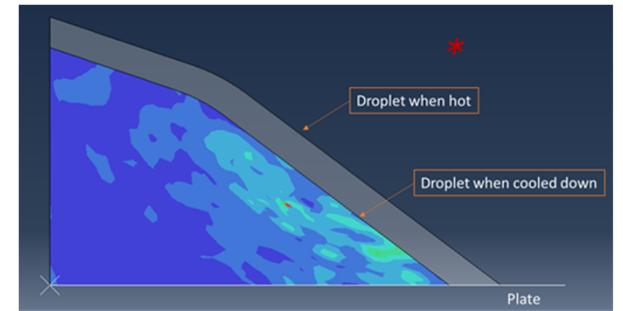


Films and stresses



Due to the high aspect ratio

Which molecular behaviour can we use?



** Credit: Vinay Damodaran @Shaping_Matter*

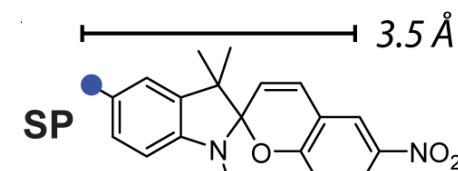


The sensory chemistry

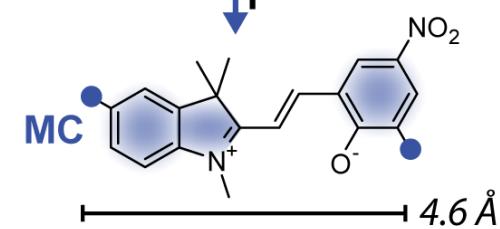


Mainly SP

Partially MC



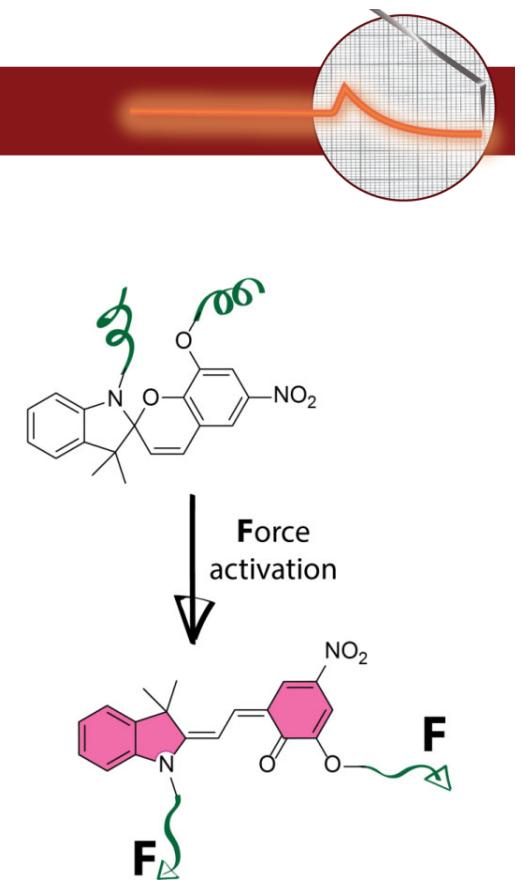
Generally the
ground state



Mechano-, thermo-
or photochemically
induced

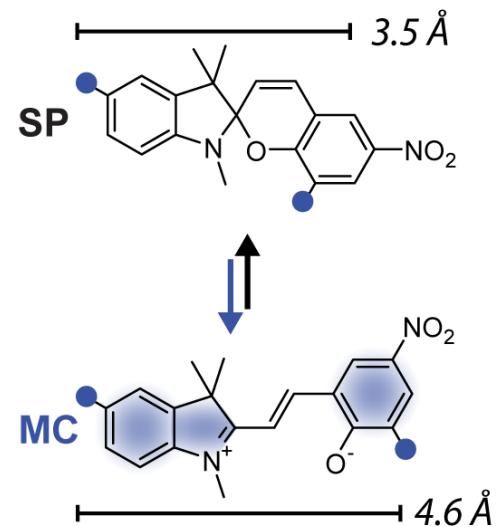
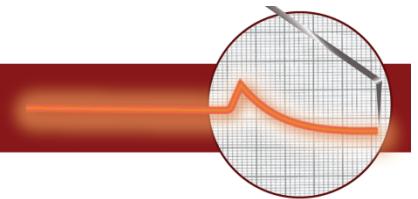


SPs in action



Demo: Craig group YouTube Channel, Duke University

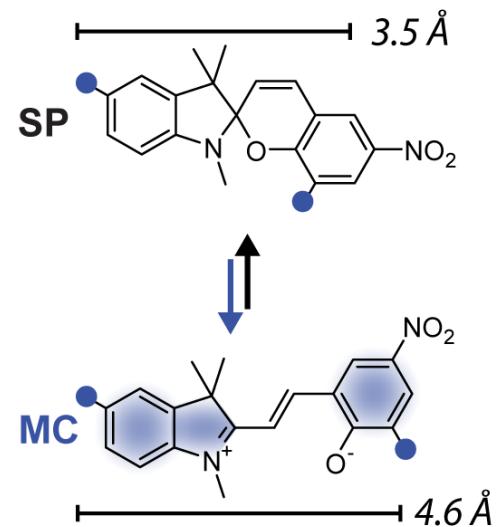
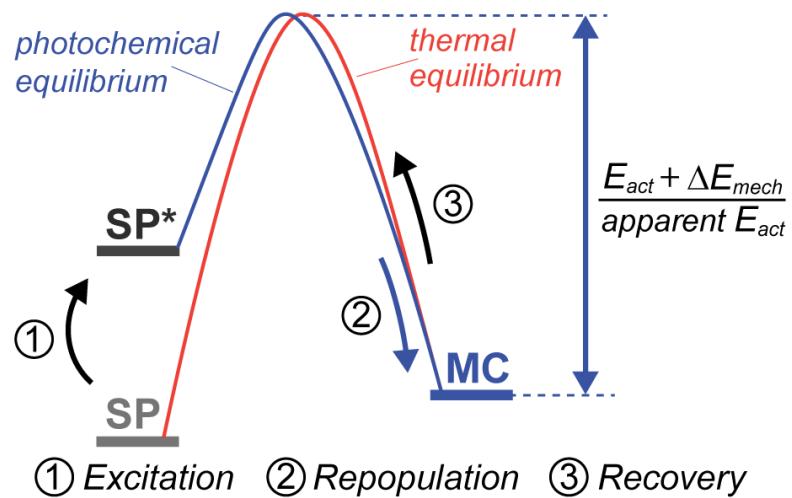
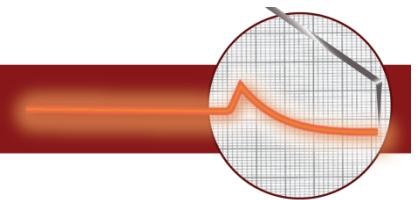
The sensory chemistry



Molecular lengths change significantly during equilibration



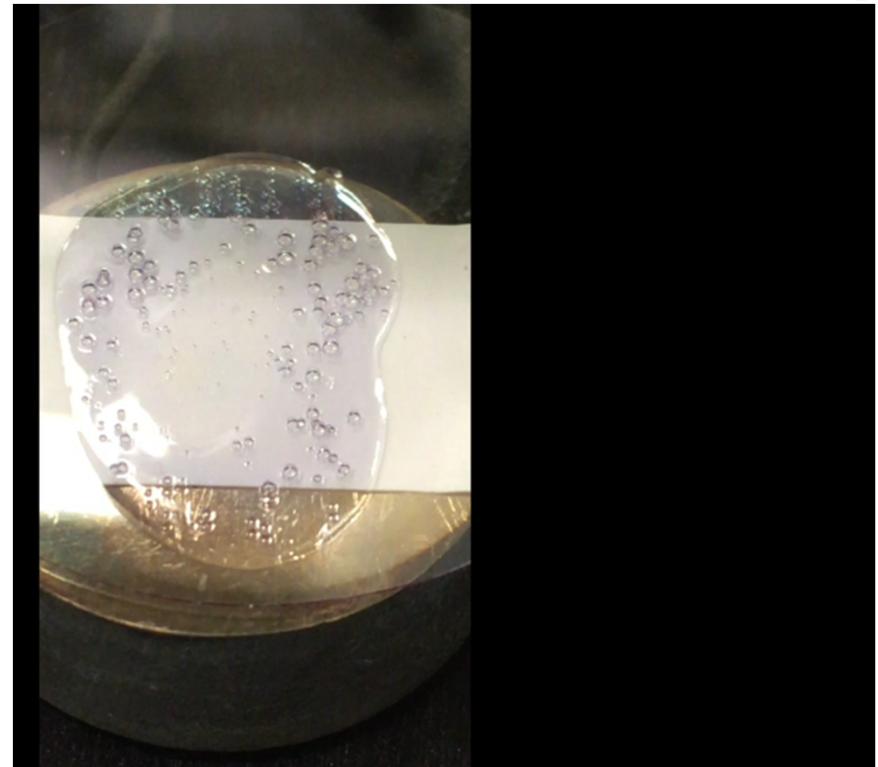
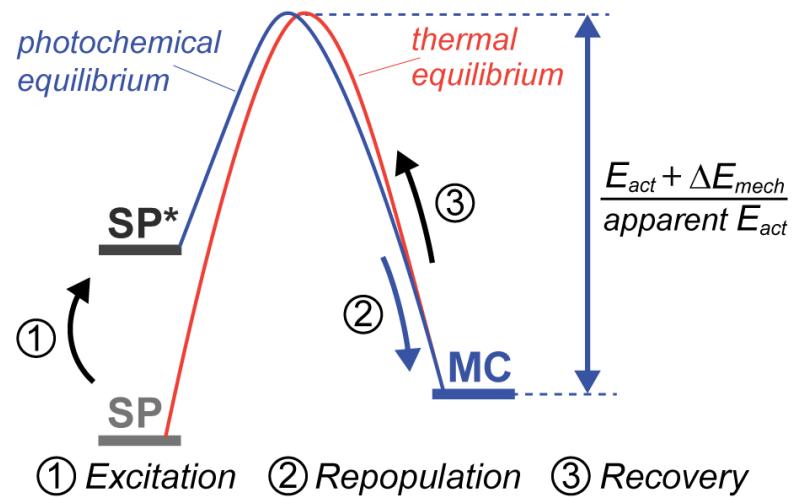
The sensory chemistry



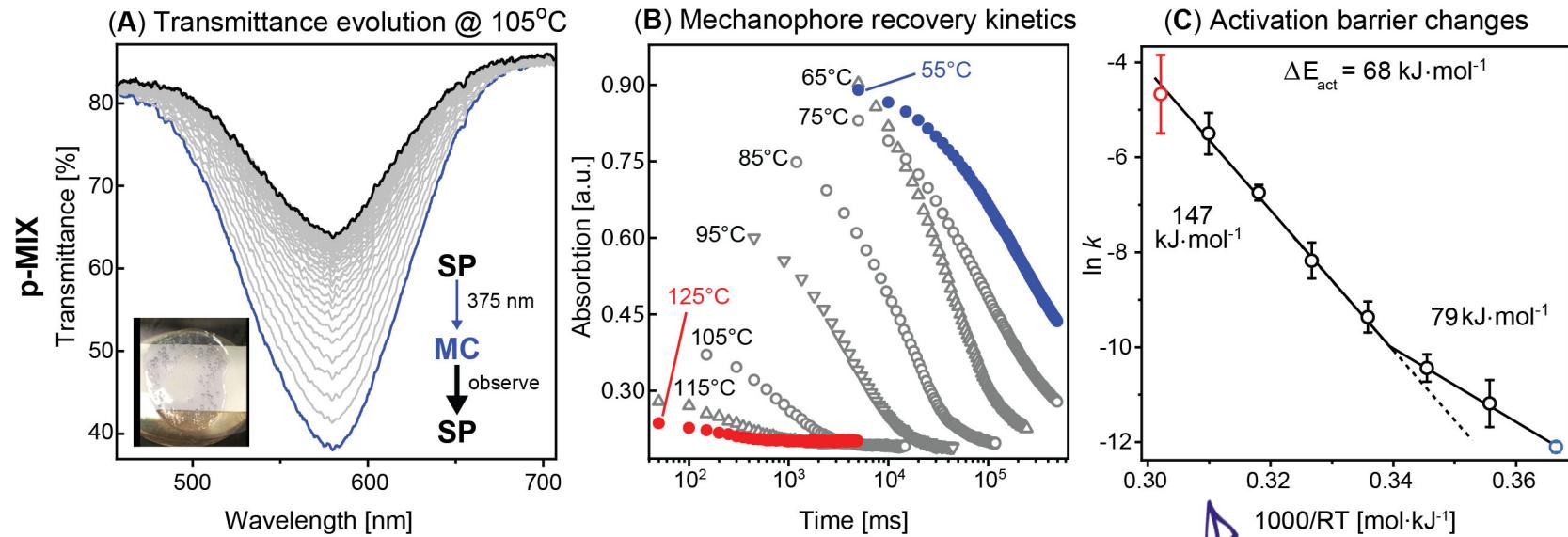
Measuring (3) we can examine biases induced by the film formation



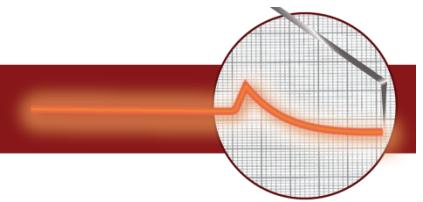
The sensory chemistry



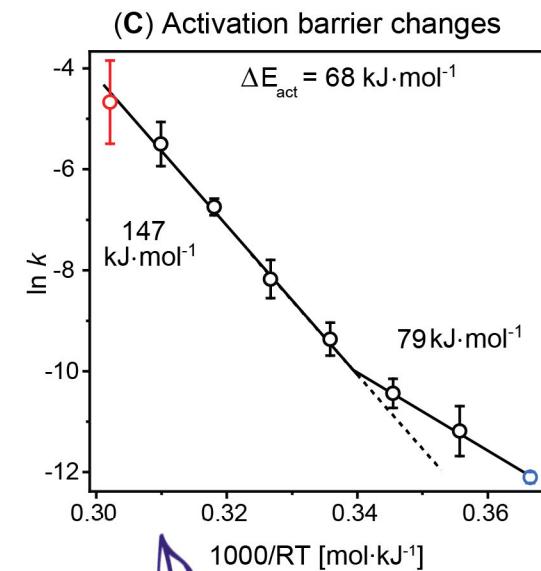
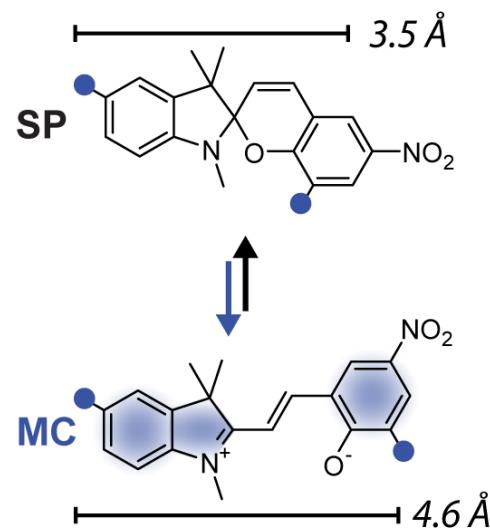
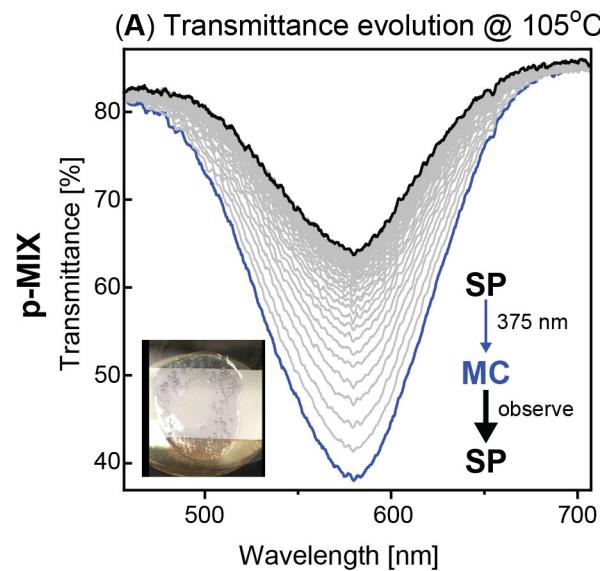
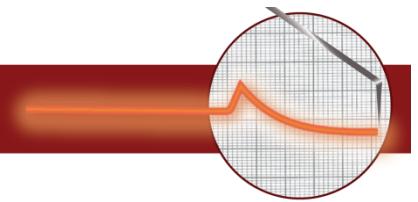
The bias



Double Arrhenian, not glassy WFL



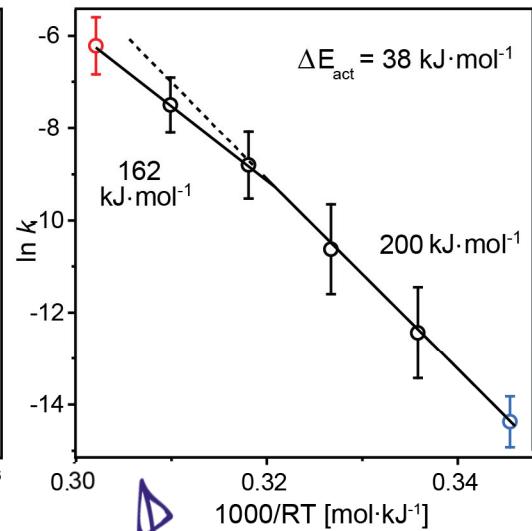
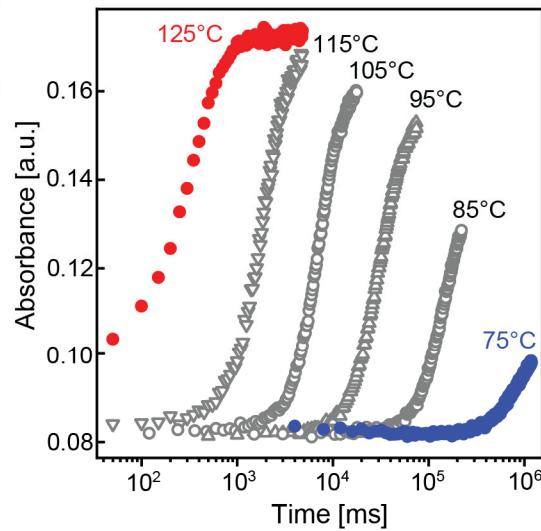
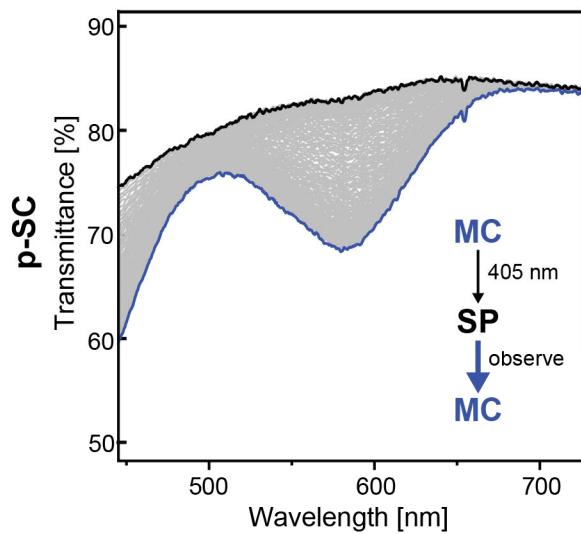
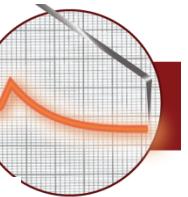
The direction of bias



Difference is due to compressive stress



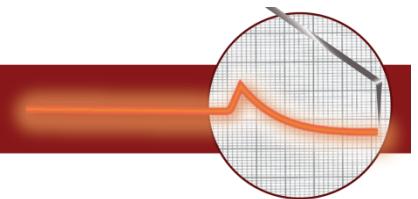
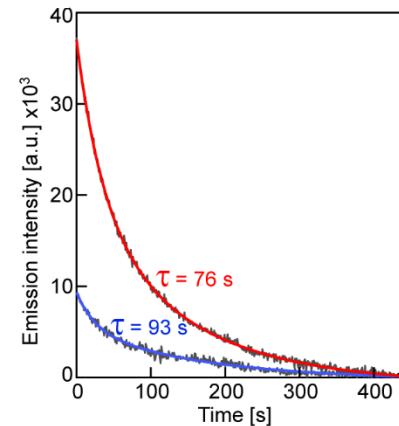
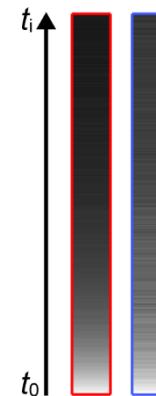
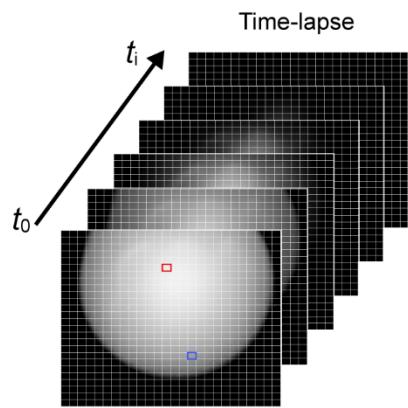
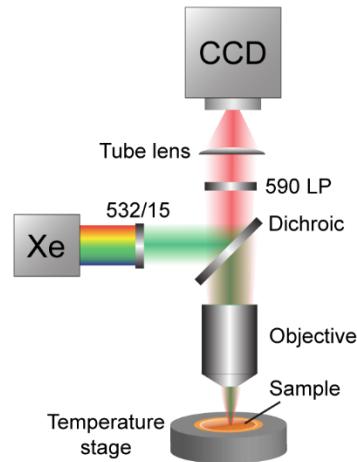
Ends should meet



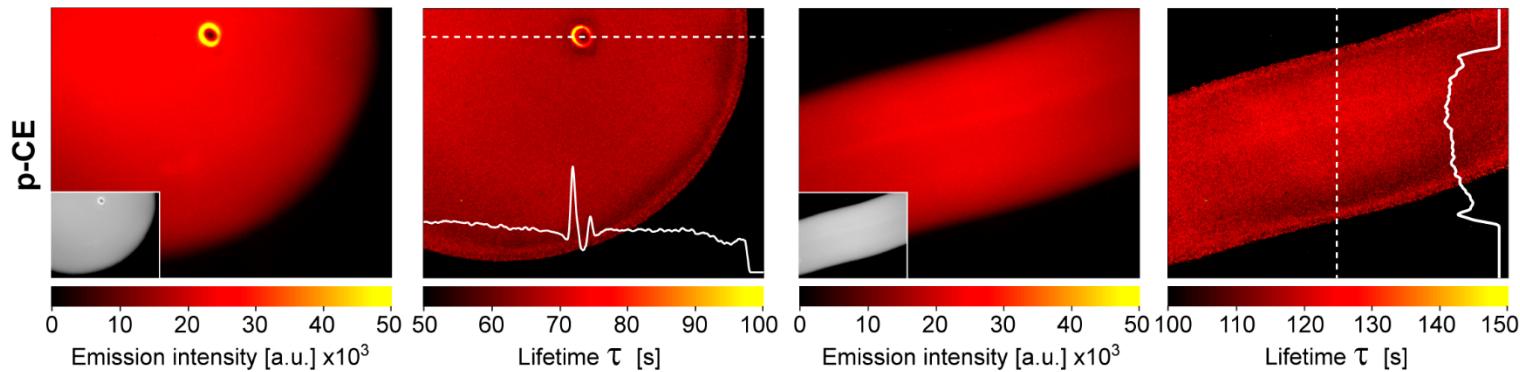
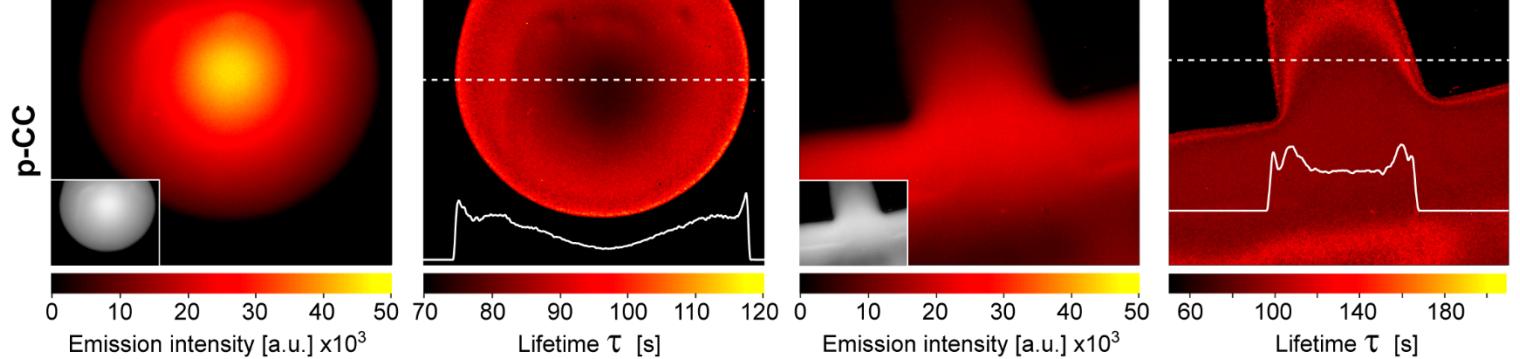
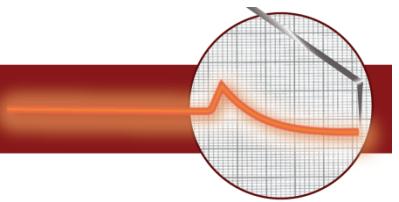
*Sensitive to polymer topology and probe placement
Reaction is reverse but stress is still compressive*



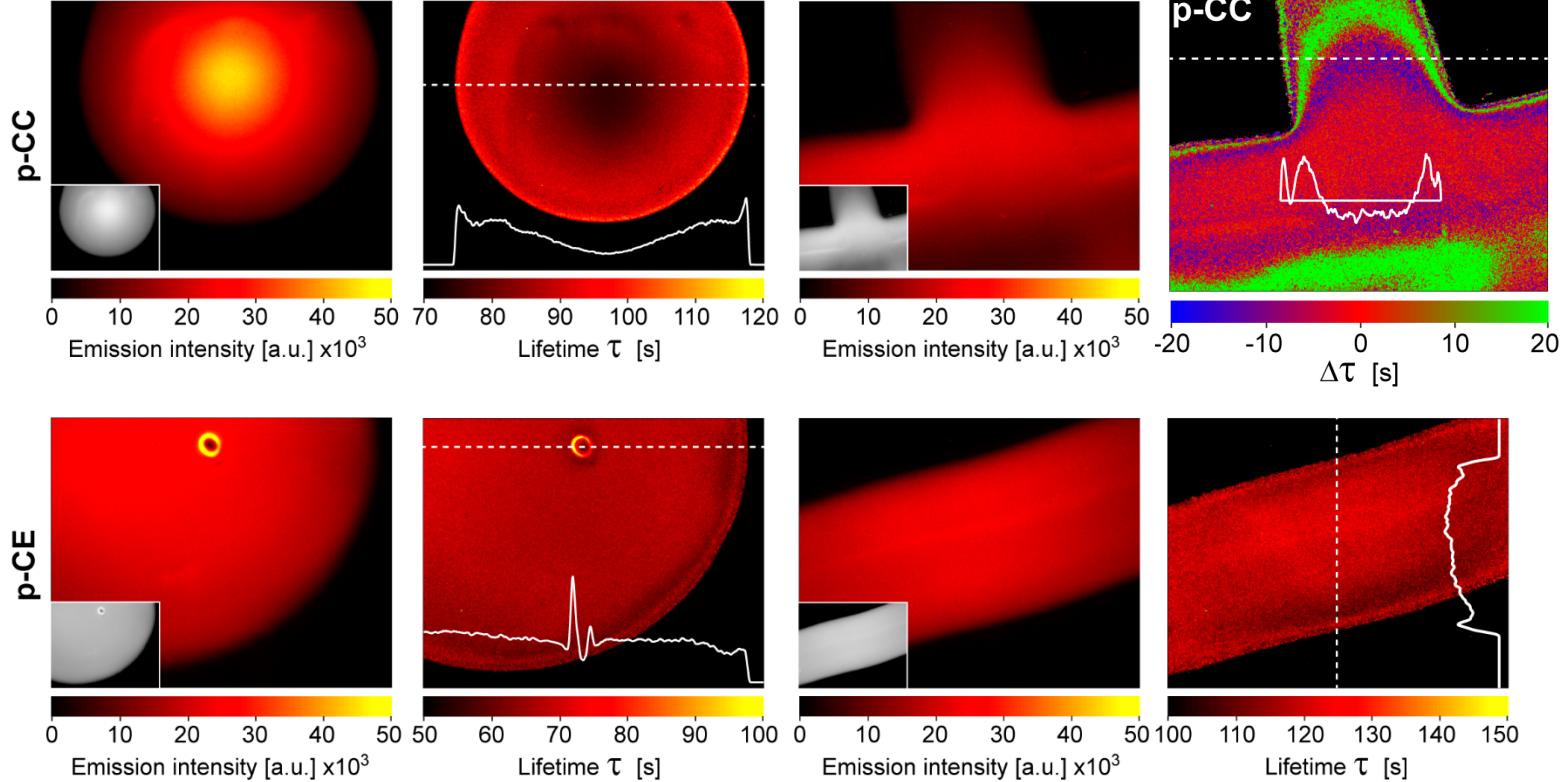
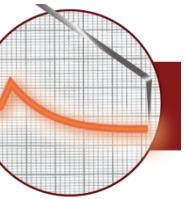
Large enough for imaging



Large enough for imaging



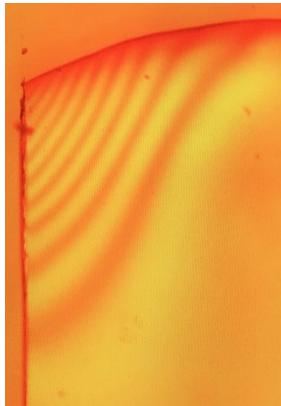
Large enough for imaging



Final thoughts

Stresses on molecular level are significantly more heterogeneous than expected.

Even for annealed samples.



Read about it: JACS 2022, 144, 50, 23198

“Excellent!”

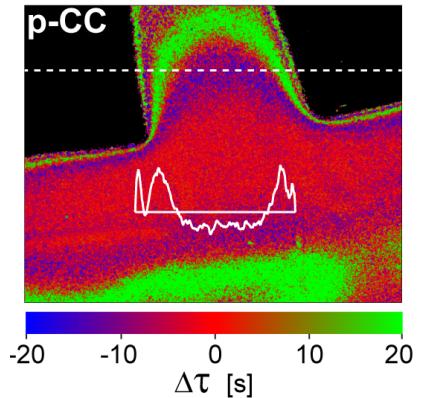
-Reviewer 1

“Very insightful”

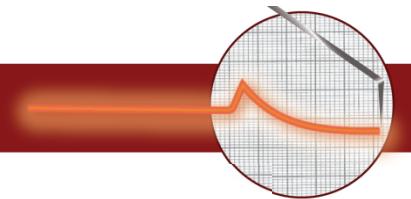
-Reviewer 3

“This makes no physical sense”

-Reviewer 2



The wrong question



The Packing of Granular Polymer Chains

Ling-Nan Zou,^{1,*} Xiang Cheng,^{1,2} Mark L. Rivers,³ Heinrich M. Jaeger,¹ Sidney R. Nagel¹

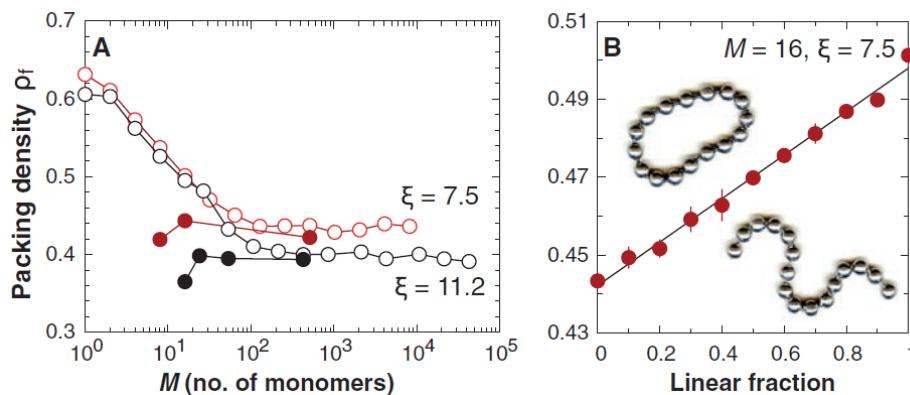


Fig. 1. (A) Packing density p_f of ball-chains versus chain length M after 10^4 taps, for both linear (open circles) and cyclic (solid circles) chains. Each data point is the average of five trials; error bars are smaller than the size of the symbols. (B) Packing density of a mixture of linear and cyclic chains (both with $M = 16$) as a function of the fraction of linear chains. Solid line is a linear fit.

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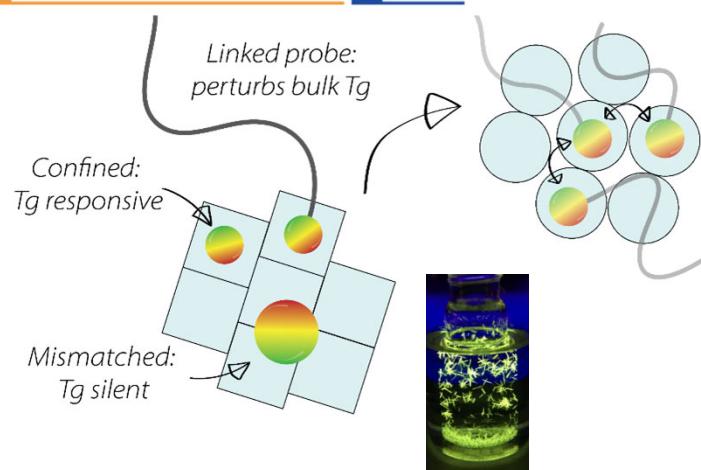
Article

Environmentally Sensitive Luminescence Reveals Spatial Confinement, Dynamics, and Their Molecular Weight Dependence in a Polymer Glass

Stephen J. Picken and Georgy A. Filonenko*

Cite This: ACS Appl. Polym. Mater. 2021, 3, 4977–4983

Read Online



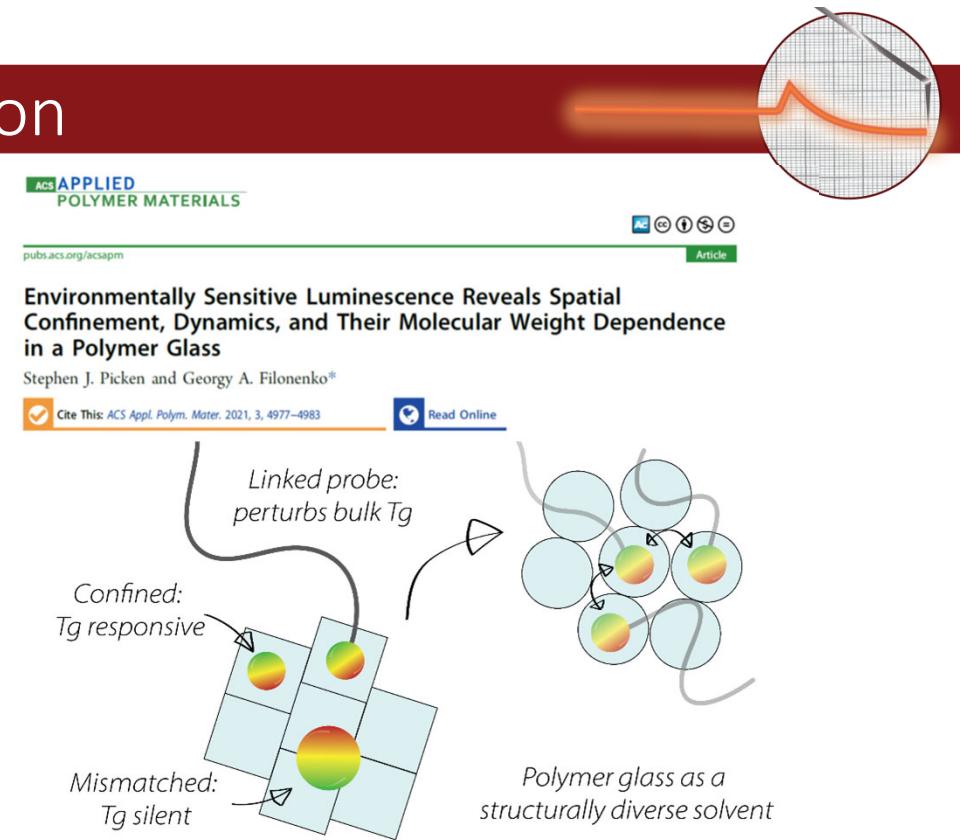
Granular chains resemble real ones

They both jam and show identical $f(M_n)$



The wrong question

If probes reflect jamming
they should (surely) reflect
non-Arrhenian behaviour too



Granular chains resemble real ones

They both jam and show identical $f(M_n)$

