

# Soft Matter

Where physics meets chemistry meets biology for fundamental soft matter research

[rsc.li/soft-matter-journal](http://rsc.li/soft-matter-journal)

The Royal Society of Chemistry is the world's leading chemistry community. Through our high impact journals and publications we connect the world with the chemical sciences and invest the profits back into the chemistry community.

## IN THIS ISSUE

ISSN 1744-6848 CODEN SMOABF 21(21) 4121-4308 (2025)



### Cover

See Piero Baglioni *et al.*, pp. 4165–4176. Image reproduced by permission of Andrea Casini from *Soft Matter*, 2025, 21, 4165. Cover art by Andrea Casini.



### Inside cover

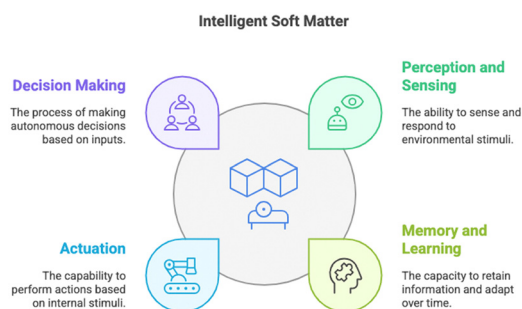
See Emiko Mouri *et al.*, pp. 4146–4149. Image reproduced by permission of Emiko Mouri from *Soft Matter*, 2025, 21, 4146. Image credit: Ms. Rie Yamasaki.

## PERSPECTIVE

4129

### Intelligent soft matter: towards embodied intelligence

Vladimir A. Baulin,\* Achille Giacometti, Dmitry A. Fedosov, Stephen Ebbens, Nydia R. Varela-Rosales, Neus Feliu, Mithun Chowdhury, Minghan Hu, Rudolf Fuchsli, Marjolein Dijkstra, Matan Mussel, René van Roij, Dong Xie, Vassil Tzanov, Mengjie Zu, Samuel Hidalgo-Caballero, Ye Yuan, Luca Cocconi, Cheol-Min Ghim, Cécile Cottin-Bizonne, M. Carmen Miguel, Maria Jose Esplandiú, Juliane Simmchen, Wolfgang J. Parak, Marco Werner, Gerhard Gompper and Martin M. Hanczyc

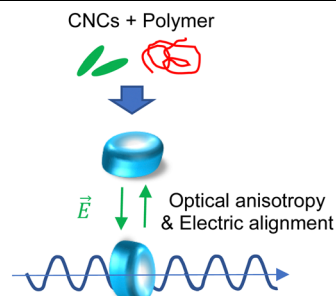
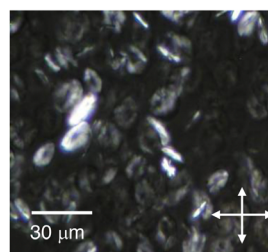


## COMMUNICATIONS

4146

### Multiple anisotropy of cellulose nanocrystals self-organized into disc-shaped particles

Emiko Mouri,\* Kenta Noma, Keito Hirayama, Ryohei Iwahisa, Satsuki Azuma and Teruyuki Nakato



# Royal Society of Chemistry approved training courses

Explore your options.  
Develop your skills.  
Discover learning  
that suits you.

**Courses in the classroom,  
the lab, or online**

Find something for every  
stage of your professional  
development. Search our  
database by:

- subject area
- location
- event type
- skill level

Members **get at least 10% off**

Visit [rsc.li/cpd-training](https://rsc.li/cpd-training)



**SAVE  
10%**

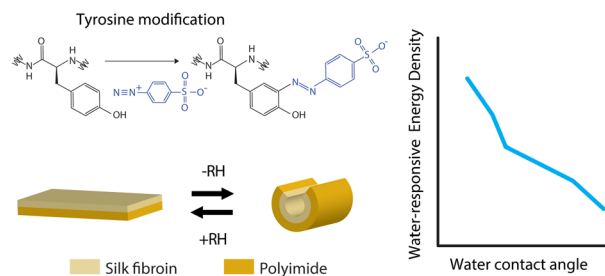


## COMMUNICATIONS

4150

**Modulating water-responsive actuation energy of regenerated silk fibroin via tyrosine modification**

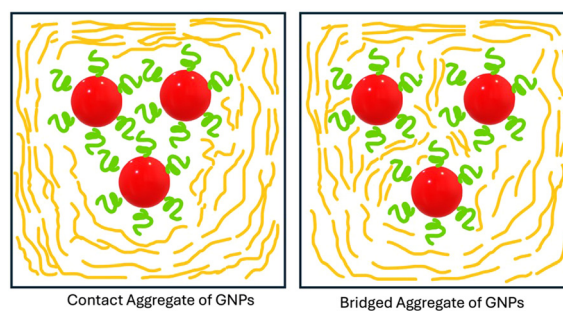
Maheen K. Khan, Vignesh Athiyarath, Darjan Podbevšek, Yeojin Jung, Seungri Kim, Yuchen Zhang, Gonca Kilavuz-Ecker, Raymond S. Tu and Xi Chen\*



4156

**Thickening of liquids using copolymer grafted nanoparticles**

Prama Adhya, Sachin M. B. Gautham, Tarak K. Patra,\* Manish Kaushal\* and Titash Mondal\*

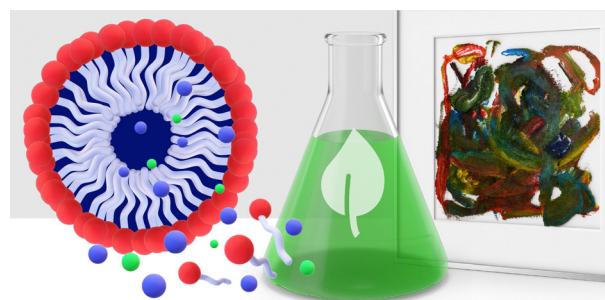


## PAPERS

4165

**New perspectives on green and sustainable wet cleaning systems for art conservation**

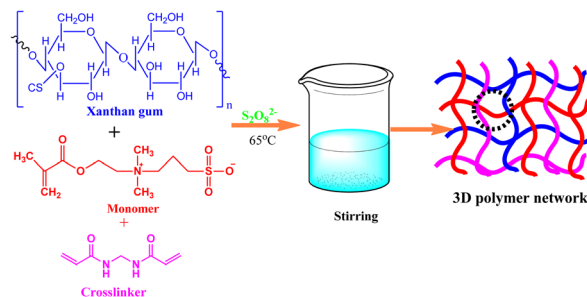
David Chelazzi, Romain Bordes, Andrea Casini, Rosangela Mastrangelo, Krister Holmberg and Piero Baglioni\*



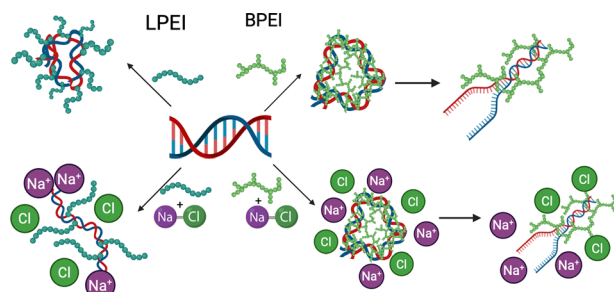
4177

**Developing multifunctional zwitterionic-xanthan gum-anchored network copolymers for biomedical applications**

Vikrant Sharma,\* Disha Kapil and Baljit Singh



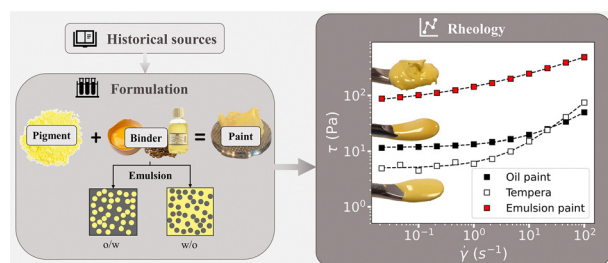
4192



### Revealing two distinct molecular binding modes in polyethyleneimine–DNA polyplexes using infrared spectroscopy

Rusul Mustafa, Danielle Diorio, Madeline Harper and David Punihaole\*

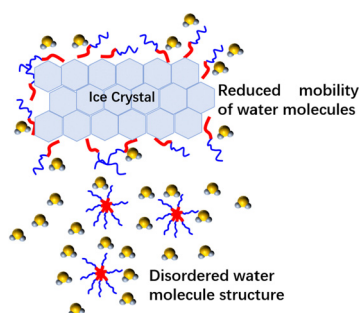
4201



### Rheological and structural characterization of emulsion-based paints

Côme Thillaye du Boullay, Maguy Jaber, Céleste Coulont and Laurence de Viguierie\*

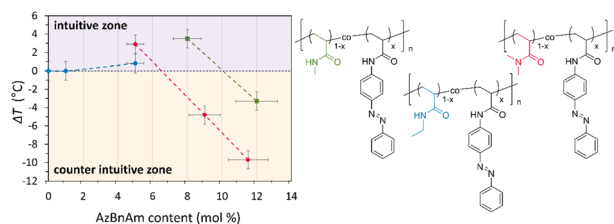
4211



### L-Methionine sulfoxide and L-alanine copolymers for ice control

Huimin Han, Qingjing Niu, Kongying Zhu, Xiaoyan Yuan and Lixia Ren\*

4220



### Counter-intuitive photo-modulation of the aqueous phase behavior of azo dye-functionalized polyacrylamides

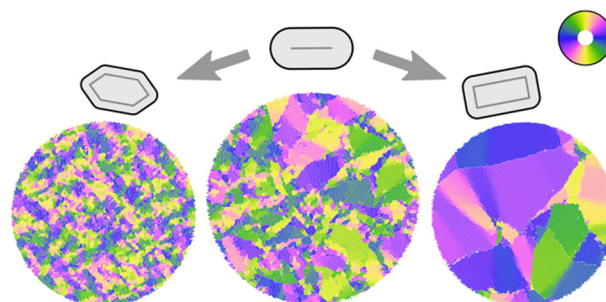
René Steinbrecher, Peiran Zhang, Christine M. Papadakis, Peter Müller-Buschbaum, Andreas Taubert and André Laschewsky\*



4233

### Sensitive particle shape dependence of growth-induced mesoscale nematic structure

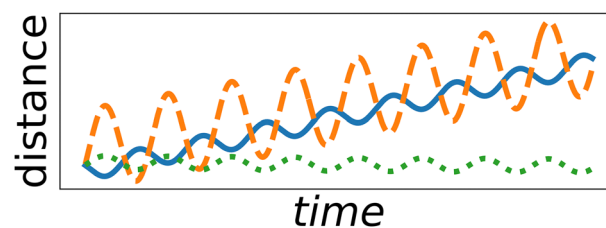
Jonas Isensee and Philip Bittihn\*



4241

### Amoeboid propulsion of active solid bodies, vesicles and droplets: a comparison

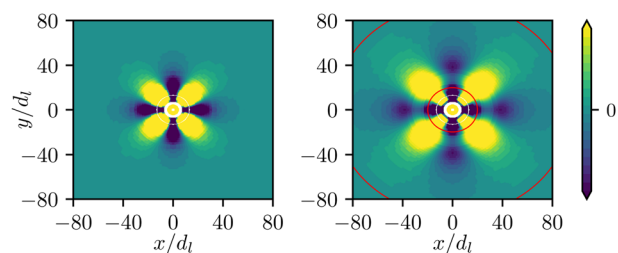
Reiner Kree\* and Annette Zippelius\*



4256

### Stress correlations and stress memory kernels in viscoelastic fluids

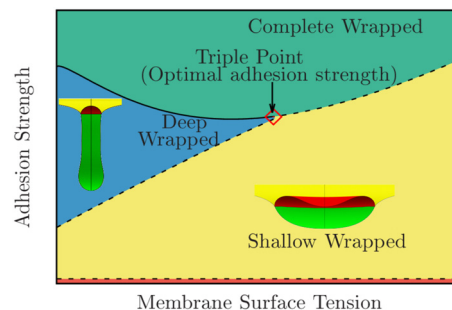
Niklas Grimm, Jörg Baschnagel, Alexander N. Semenov, Annette Zippelius and Matthias Fuchs\*



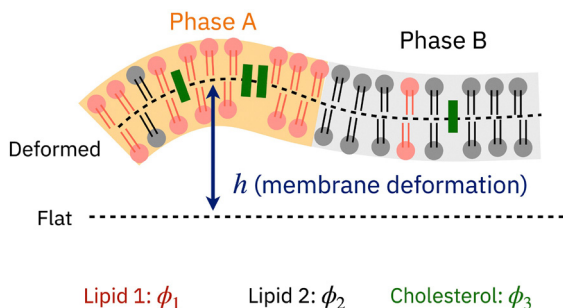
4275

### Wrapping nonspherical vesicles at bio-membranes

Ajit Kumar Sahu, Rajkumar Malik and Jiarul Midya\*



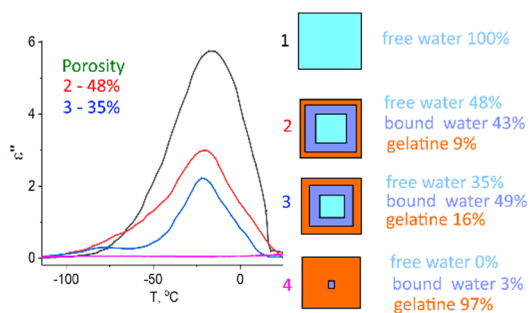
4288



### Pattern formation of lipid domains in bilayer membranes

Qiwei Yu and Andrej Košmrlj\*

4298



### Determining hydrogel porosity through dielectric relaxation intensity ratios between water and hydrogel

Maksym M. Lazarenko,\* Yuriy F. Zabashta, Dmytro. K. Honcharuk, Oleksandr M. Alekseev, Kateryna S. Yablochkova, Liena Yu. Vergun, Dmytro A. Andrusenko, Mykhaylo V. Lazarenko and Leonid A. Bulavin

## EXPRESSION OF CONCERN

4306

### Expression of concern: Substrate induced differentiation of human mesenchymal stem cells on hydrogels with modified surface chemistry and controlled modulus

Mathieu Lanniel, Ejaz Huq, Stephanie Allen, Lee Buttery, Philip M. Williams and Morgan R. Alexander\*

