INTERNATIONAL SOLVAY INSTITUTES BRUSSELS

2020 International Solvay Chair in Chemistry

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4 ONLINE LECTURES VIA ZOOM

THURSDAY 22 APRIL 2021 AT 3:00 PM
Bio-Inspired Approaches to Crystal Design

Nature produces a wide variety of exquisite mineralized tissues fulfilling diverse functions, and often from simple inorganic salts. Organisms exercise a level of molecular control over the physico-chemical properties of inorganic crystals that is unparalleled in today's technology. This reflects directly or indirectly the controlling activity of biological organic surfaces that are involved in the formation of these materials. Biomineralization occurs within specific microenvironments, which implies stimulation of crystal formation at certain interfacial sites and relative inhibition of the process at all other sites. Our approach to artificial crystallization is based on the combination of the two latter concepts: that is, the use of organized organic surfaces patterned with specific initiation domains on a sub-micron scale to study and orchestrate the crystallization process. This bio-inspired engineering effort made it possible to achieve a remarkable level of control over various aspects of crystal nucleation and growth, including the precise localization of particles, nucleation density, crystal sizes, morphology, crystallographic orientation, arbitrary shapes, microstructure, stability and architecture. The ability to construct large, defect-free, micropatterned single crystals with controlled microporosity; periodic arrays of uniform, oriented crystals or films presenting patterns of crystals offers a new synthetic methodology to materials engineering.

Zoom link: https://zoom.us/j/96056738754?pwd=UkE3b2Q4cmlyc3lsOS8xWTZrWUZPQT09

THURSDAY 29 APRIL 2021 AT 3:00 PM
Colloidal Crystallization: from Structural Color to Encryption, to Medical Diagnostics to Catalysis

This lecture will introduce a reproducible, one-pot sol-gel colloidal co-assembly approach that results in large-scale, highly ordered inverse opal films with embedded, uniformly distributed, and accessible nanoparticles. The unique coloration of these inverse opals combines iridescence with plasmonic effects. When locally functionalized, these films exhibit a sharply defined threshold wettability for infiltration that couples to macroscopic color changes. This approach may find applications in a broad range of technologies, including a convenient and direct method for liquid detection and encryption, or as a tag for low-cost monitoring of tampering or material aging. Extension of this methodology to create a new class of highly stable heterogeneous catalysts will also be discussed.

Zoom link: https://zoom.us/j/99453173543?pwd=Sjc5ZDg3US9BTFZoL3hzZ3NCK1FFdz09

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THURSDAY 6 MAY 2021 AT 3:00 PM

Hydrophobicity, Ice-phobicity and Oleophobicity: from Lotus to Pitcher Plant

This lecture will describe chemical and physical principles of liquid-phobic surfaces. Creating a robust synthetic material with antifouling properties would have broad technological implications for areas ranging from biomedical devices to fuel transport to architecture but has proven to be extremely challenging. Inspirations from natural nonwetting structures, particularly the lotus, surged the development of liquid-repellent microtextured surfaces that rely on the formation of a stable air-liquid interface. Despite over a decade of intense research, these surfaces are, however, still plagued with problems that restrict their practical applications: they show limited oleophobicity with high contact angle hysteresis; do not prevent ice formation; fail under pressure and upon any physical damage; cannot self-heal, and are expensive to produce. To address these challenges, I will introduce a new strategy to create self-healing, Slippery Lubricant-Infused Porous Surfaces (SLIPS) that outperform state-of-the-art synthetic surfaces in their ability to resist ice and microbial adhesion and repel various simple and complex liquids.

Zoom link: https://zoom.us/j/97430814313?pwd=dFVaZzBrek9hM0JHb0UzMTlVYUtIdz09

THURSDAY 20 MAY 2021 AT 3:00 PM

Actuated 'Hairy' Surfaces: En Route for Adaptive, Homeostatic Materials

Dynamic structures that respond reversibly to changes in their environment are central to self-regulating thermal and lighting systems, targeted drug delivery, sensors, and self-propelled locomotion. Since an adaptive change requires energy input, an ideal strategy would be to design materials that harvest energy directly from the environment and use it to drive an appropriate response. This lecture will present the design of a novel class of reconfigurable materials that use 'hairy' surfaces bearing arrays of nanostructures put in motion by environment-responsive gels. Their unique hybrid architecture, and chemical and mechanical properties can be optimized to confer a wide range of adaptive behaviors. Using both experimental and modeling approaches, we are developing these hydrogel-actuated integrated responsive systems (HAIRS) as new materials with reversible optical and wetting properties, as a multifunctional platform for controlling cell differentiation and function, and as a first homeostatic system with autonomous self-regulation.

Zoom link: https://zoom.us/j/94005080719?pwd=b2JqKzFiN2l4MFE4Z3J5UWxlMTI2Zz09