화학과 세미나

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Colloid and Interface Self-Assembly Creating Dynamic Nanostructures

Colloidal self-assembly at interfaces offers a powerful strategy for designing dynamic soft materials with tunable optical, mechanical, and functional properties This talk highlights recent advances in the fabrication of intelligent polymer colloids, structurally colored photonic materials, and freestanding nanoparticle (NP) networks, demonstrating how interfacial engineering and phase separation can drive the emergence of novel architectures. The presentation begins with the design of full-color reflective photonic polymer particles capable of dynamic shape and color modulation under external stimuli such as magnetic fields and pH variation. The underlying principles of surfactant-driven phase separation will be discussed, emphasizing the formation of anisotropic colloidal morphologies, including Janus and ellipsoidal particles. A scalable strategy for creating 3D photonic pigments via the self-assembly of amphiphilic block copolymers (BCPs) in emulsion droplets is then introduced. By modulating interfacial instability and nanoscale porosity, inverse photonic glass architectures with tunable structural colors are achieved, offering a sustainable alternative to conventional pigments. The final section presents a Pickering emulsion-mediated interfacial assembly approach for producing ultrathin, bicontinuous carbon NP films with high surface area and structural robustness. These freestanding films can be conformally transferred onto diverse substrates, including micro-patterned and flexible surfaces, enabling next-generation stretchable device applications. Together, these studies illustrate the versatility of colloid and interface self-assembly as a platform for engineering responsive soft materials with broad implications in photonics, sensing, and flexible electronics.

Date : 2025년 5월 22일 (목) 오후 5시
Venue : 과학관 B133호
Host : 연세대학교 화학과