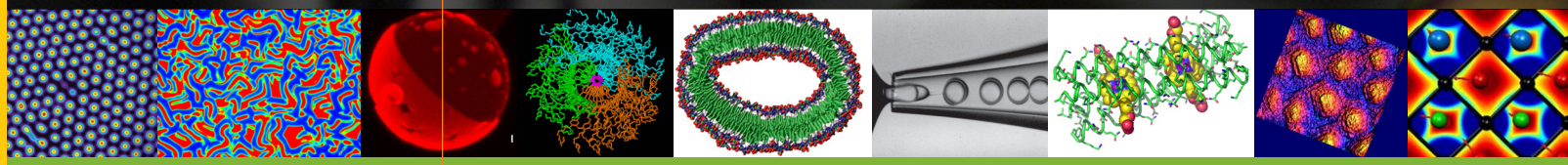
UPENN

Filamentous Networks & Structured Gels
Functional Cylindrical Assemblies
Designed Programmable Membranes
De Novo Synthetic Protein Modules for Light-Capture and Catalysis Oxide-Based
Hierarchical Interfacial Materials



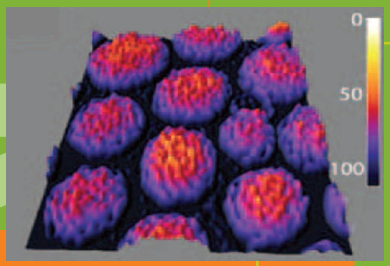
University of Pennsylvania

LRSM

The Laboratory for Research on the Structure of Matter (LRSM) at the University of Pennsylvania (Penn) is host to the NSF Materials Research Science & Engineering Center (MRSEC).

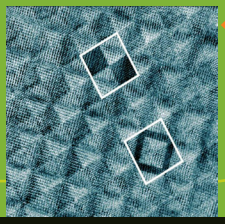
The LRSM MRSEC program employs a multi-disciplinary approach that integrates design, synthesis, characterization, theory & modeling of materials to solve fundamental problems that are likely to underlie applications of future technologies and, thereby, substantially impact the research, educational & economic needs of society. Center research is balanced between "soft" and "hard" matter, spanning from atomic-level solids & interfaces to colloidal & granular media to liquid crystals, responsive gel networks & synthetic analogues of biomembranes. Recurrent themes are interfaces, assembly, design rules, and the goal to create heretofore un-synthesized advanced materials with unique properties & applications. New materials constructs range from de novo designed proteins & macromolecules (dendrimers, polymersomes) to superlattices of nanocrystals & stable oxide architectures with electrochemical activities suitable for high-T solid oxide fuel cell applications. New materials concepts range from exploration of how the geometry of boundaries and interfaces can be used to influence soft matter morphology & dynamics to the development of packing design rules for fabricating materials resistant to mechanical failure.

HIGHLIGHTS . . .



Synthesis of libraries of amphiphilic Janus-dendrimers that spontaneously form vesicles and other complex architectures including micelles, disks, long aspect-ratio vesicles & twisted ribbons.

Size-tunable complex "nanochessboard" patterns produced in bulk Nd/Li-TiO_3 systems, driven by a large size difference between Nd and Li.



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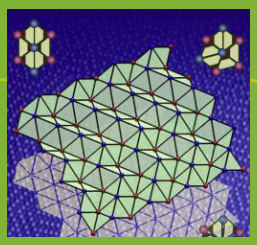
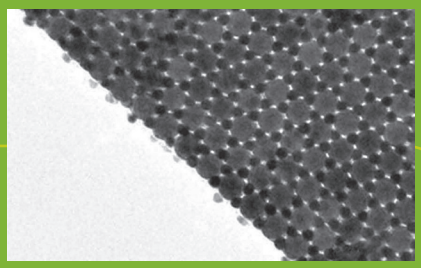
http://www.lrsm.upenn.edu

HIGHLIGHTS . . .

Mixtures of anionic & neutral polymer amphiphiles and divalent cations self-assemble into meso-scale domains on cylinder micelles and vesicles.



Geometric frustration in buckled colloidal monolayers builds a novel bridge between two very different fields of materials science: soft matter and frustrated magnetism.



Centimeter-scale membranes of binary nanocrystal superlattices, created by crystallizing a mixture of nanocrystals on a liquid surface, have hybrid magnetic properties.

Shared Experimental Facilities

A suite of Shared Experimental Facilities (www.lrsm.upenn.edu/facilities) support research activities and are available to outside users on- and off-campus. Facilities include advanced instrumentation for materials characterization centered on X-ray scattering, electron microscopy, confocal microscopy, rheometry, electronic, thermal and magnetic responses, optical spectroscopy, and scanning probe microscopies.

EDUCATION & OUTREACH

- **Outreach to K-12** includes our **PSSI** program which brings 24 high school students to the MRSEC for four weeks of lectures, experimental labs and visits to industrial labs. We also videoconference interactive lectures to multiple schools through **Penn's MAGPI Internet II network,** and we broadcast science programs through the Philadelphia school system's Cable TV station.
- **Research partnerships** have been developed between us and minority faculty and students both with the **University of Puerto Rico** through our **PREM** program (1998-present) and universities in **Southern Africa** (2003-present)
- **For high school teachers,** a monthly lecture series by MRSEC faculty is accompanied by workshops on materials lab experiments and one workshop on *Science in Archaeology.* Approximately 500 undergraduates have completed our 10 week REU program over the last 20 years, and we have instituted a series of **Science Cafés** for laypeople.

OUTREACH

More information about the outreach at the LRSM, Penn's MRSEC, can be found at: www.lrsm.upenn.edu/outreach/