

ADVANCED FUNCTIONAL MATERIALS

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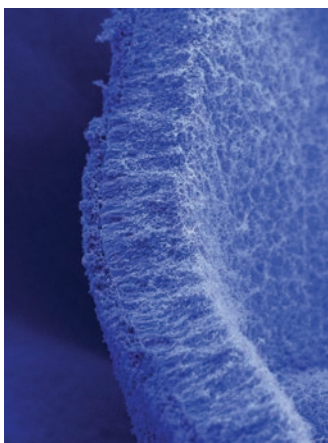
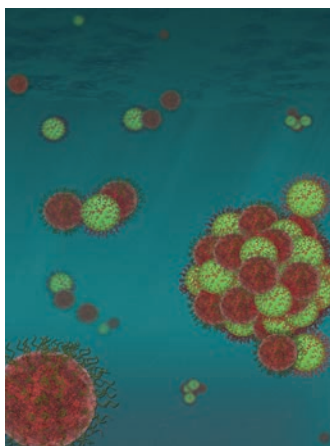


Tissue Engineering

A new composite platform for the delivery of bioactive molecules is obtained by embedding mesoporous silicon particles in poly(DL-lactide-co-glycolide) (PLGA) microspheres. As reported on page 282 by Ennio Tasciotti and co-workers, this system can be synthesized and tuned to tailor size, density, and delivery kinetics to the application of choice. This hybrid system displays emerging features and properties that depend on the interactions of the two materials at the molecular and nanoscale.

Nanocomposites

The fabrication of high-energy Al/CuO nanocomposites by nanoparticle DNA-directed assembly is reported by Aurélien Bancaud, Carole Rossi, and co-workers on page 323. The complementarity of the strands attached to the Al and CuO nanoparticles enables the assembly of micrometer-sized aggregates, which release heat upon thermal actuation, to be directed. The actuation temperature of 410 °C of these materials is among the lowest reported. The image shows an artistic view of Al/CuO nanocomposite fabrication through DNA-directed assembly.



Self-Assembly

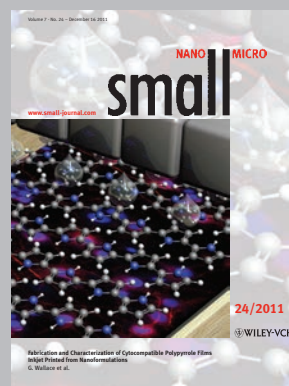
The superposition of intermolecular interactions and extrinsic forces can be used to control the properties of self-assembled materials. On page 369 Samuel I. Stupp and co-workers investigate the role of electric fields during the interfacial self-assembly of a hierarchically ordered membrane from oppositely charged molecules and demonstrate profound changes in the growth rate and orientation, as well as properties.



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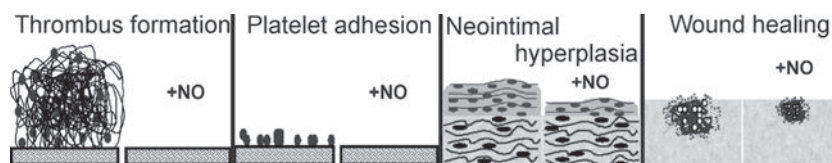
FEATURE ARTICLE

Biomedical Materials

M. C. Jen, M. C. Serrano, R. van Lith,
G. A. Ameer*239–260

**Polymer-Based Nitric Oxide Therapies:
Recent Insights for Biomedical
Applications**

Nitric oxide-releasing and -generating polymeric materials are currently under investigation for biomedical applications. Clinical complications such as thrombus formation (first panel), platelet adhesion (second panel), neointimal hyperplasia (third panel), and wound healing (last panel) may benefit from advances in this field. Recent progress in the topic is reviewed herein.

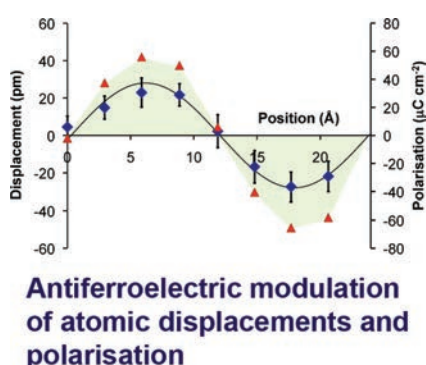


FULL PAPERS

Atomic-Scale Imaging

I. MacLaren,* R. Villaurretia,
B. Schaffer, L. Houben,
A. Peláiz-Barranco261–266

**Atomic-Scale Imaging and
Quantification of Electrical Polarisation
in Incommensurate Antiferroelectric
Lanthanum-Doped Lead Zirconate
Titanate**

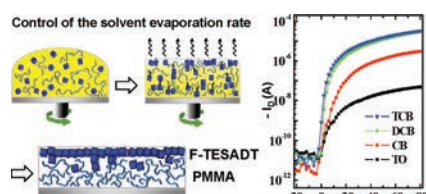


The structure of two stacking sequences in incommensurate antiferroelectric (Pb,La)(Zr,Ti)O₃ is determined using quantitative scanning transmission electron microscopy, with the lead atom positions located with an outstanding precision of about 6 pm. This allows the estimation of local polarisation, and this is found to vary in an approximately sinusoidal fashion along the stacking direction with peak values matching exceptionally well to reported values for commensurate PbZrO₃.

Organic Field-Effect Transistors

W. H. Lee, D. Kwak, J. E. Anthony,
H. S. Lee, H. H. Choi, D. H. Kim,
S. G. Lee, K. Cho*267–281

**The Influence of the Solvent
Evaporation Rate on the Phase
Separation and Electrical Performances
of Soluble Acene-Polymer Blend
Semiconductors**

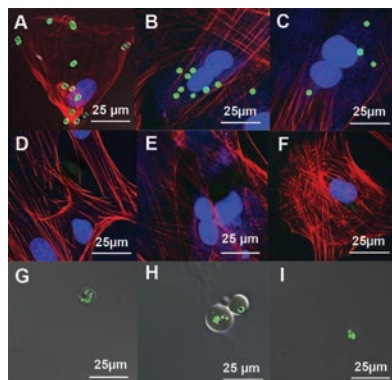


By controlling the solvent evaporation rate of spin-cast difluorinated-triethylsilyl-ethynyl anthradithiophene (F-TESADT)/poly(methyl methacrylate) (PMMA) blend solution, a bilayer structure consisting of highly ordered F-TESADT crystals on the top and low-trap PMMA dielectric on the bottom can be fabricated by a one-step process. The use of F-TESADT/PMMA blend films in transistors produces much higher field-effect mobilities and greater stability than homo F-TESADT films.

Issue Engineering

D. Fan, E. De Rosa, M. B. Murphy,
Y. Peng, C. A. Smid, C. Chiappini,
X. Liu, P. Simmons, B. K. Weiner,
M. Ferrari, E. Tasciotti*282–293

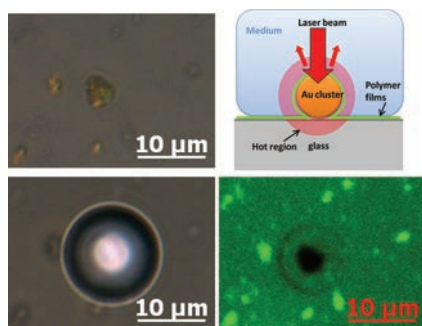
**Mesoporous Silicon-PLGA Composite
Microspheres for the Double
Controlled Release of Biomolecules
for Orthopedic Tissue Engineering**



Poly(DL-lactide-co-glycolide)/porous silicon (PLGA/pSi) composite microspheres are synthesized by a solid-in-oil-in-water (S/O/W) emulsion method. These composite microspheres can exhibit sustained protein release, preserve protein bioactivity, stimulate mineralization, neutralize the acidic pH due to the PLGA degradation by-products, and avoid uptake by cells. These microspheres are developed for the long-term controlled delivery of biomolecules for orthopedic tissue engineering applications.

FULL PAPERS

Agglomerated gold nanoparticle clusters embedded in-between multilayered polyelectrolyte matrices are excited optically. The extent of film destruction and the formation of vapor bubbles are shown to be strongly dependent on the conformation of the ambient medium. Especially the heat dissipation in biological media is shown to be entirely different from that in media without salt or protein content.

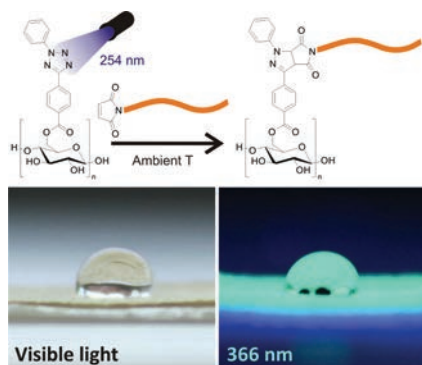


Gold Nanoparticles

D. Hühn, A. Govorov, P. Rivera Gil, W. J. Parak*294–303

Photostimulated Au Nanoheaters in Polymer and Biological Media: Characterization of Mechanical Destruction and Boiling

Photoinduced nitrile imine-alkene 1,3-dipolar cycloaddition (NITEC) is employed to covalently bind well-defined polymers onto silicon oxide or cellulose. A diaryl tetrazole-functionalized molecule is grafted via silanization or amidification, respectively. Under UV light, a reactive nitrile imine rapidly forms and reacts with maleimide-functionalized polymers yielding a fluorescent linkage. Via a masking method, polymeric fluorescent patterns are achieved.



Functional Coatings

M. Dietrich, G. Delaittre, J. P. Blinco, A. J. Inglis, M. Bruns, C. Barner-Kowollik*304–312

Photoclickable Surfaces for Profluorescent Covalent Polymer Coatings

Functionalised macroporous scaffolds have been fabricated by a decoupled two-step approach comprising plasmachemical deposition of the host material followed by spontaneous emulsion formation using templating molecules. This unique approach allows pore architecture and surface functionalisation to be tailored independently.



Scaffolds

S. Morsch, T. J. Wood, W. C. E. Schofield, J. P. S. Badyal*313–322

A Combined Plasmachemical and Emulsion Templating Approach for Actuated Macroporous Scaffolds

The fabrication of high-energy Al/CuO nanocomposites by nanoparticle DNA-directed assembly is demonstrated. The complementarity of the strands attached to the Al and CuO nanoparticles enables the assembly of micrometer-sized aggregates, which release heat upon thermal actuation, to be directed. The actuation temperature of 410 °C of these materials is among the lowest published in the literature.



Nanocomposites

F. Séverac, P. Alphonse, A. Estève, A. Bancaud,* C. Rossi*323–329

High-Energy Al/CuO Nanocomposites Obtained by DNA-Directed Assembly

FULL PAPERS

Drug Delivery

K. Tsioris, W. K. Raja, E. M. Pritchard,
B. Panilaitis, D. L. Kaplan,
F. G. Omenetto*330–335

Fabrication of Silk Microneedles for Controlled-Release Drug Delivery

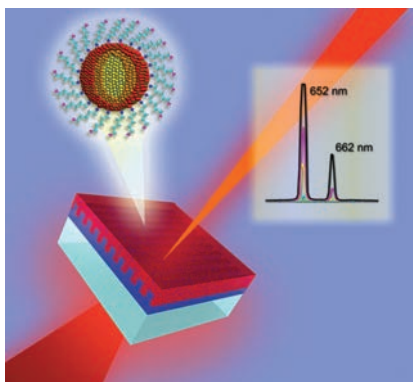


A fabrication method to produce silk biopolymer microstructures with the high aspect ratios required to manufacture microneedle systems is reported. Room temperature and aqueous-based micromolding allows the bulk loading of these microneedles with sensitive drugs. Controlled release of a model drug is achieved by adjusting the post-processing conditions of the microneedles, mainly by controlling the silk protein secondary structure.

Quantum Dots

F. Todescato, I. Fortunati, S. Gardin,
E. Garbin, E. Collini, R. Bozio,
J. J. Jasieniak, G. Della Giustina,
G. Brusatin, S. Toffanin,
R. Signorini*337–344

Soft-Lithographed Up-Converted Distributed Feedback Visible Lasers Based on CdSe–CdZnS–ZnS Quantum Dots

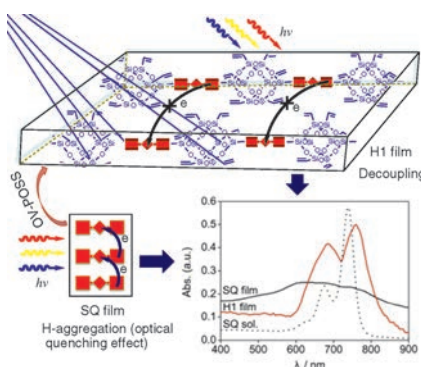


By exploiting sol–gel chemistry and the nanoimprinting process, a low-cost up-converted distributed feedback laser is realized. Properly synthesized graded CdSe–CdZnS–ZnS quantum dots are used as active gain material. The laser prototype efficiently works in the visible region, by pumping with one- or two-photon processes. This solution-processed device opens the way to the production of emission-tunable compact lasers.

Optical Materials

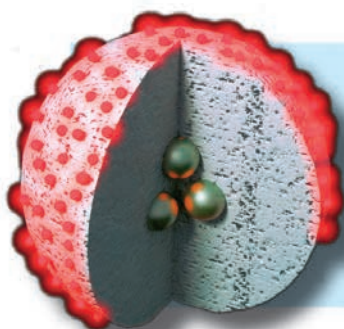
Z. Yan, H. Xu,* S. Guang, X. Zhao,
W. Fan, X. Y. Liu*345–352

A Convenient Organic–Inorganic Hybrid Approach Toward Highly Stable Squaraine Dyes with Reduced H-Aggregation



Add POSS to make definite improvement:

Incorporation of “huge” inorganic polyhedral oligomeric silsesquioxane (POSS) nanoparticles into organic optical materials via covalent bonding can effectively decrease the strong dipole–dipole and π – π stacking interactions, and inhibit intermolecular charge transfer between the chromophores to enable preparation of stable optical materials with enhanced thermal, chemical, and photostabilities.



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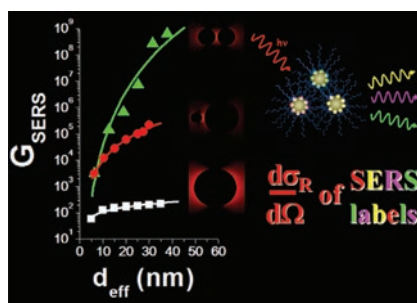
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FULL PAPERS

The brightness of surface enhanced Raman scattering (SERS) labels can be increased by several orders of magnitude by selecting the proper Raman active molecule and by controlling the size and the aggregation of the noble metal nanoparticles.

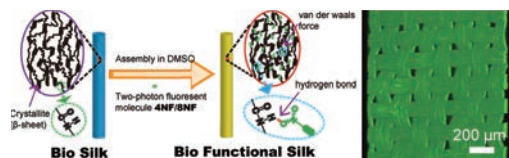


Gold Nanoparticles

V. Amendola,*
M. Meneghetti*353–360

Exploring How to Increase the Brightness of Surface-Enhanced Raman Spectroscopy Nanolabels: The Effect of the Raman-Active Molecules and of the Label Size

Luminescent silk fibers that exhibit two-photon fluorescence are prepared by combining *Bombyx mori* silk with fluorene derivatives. The enhancement mechanism is based on biomolecular recognition by decoupling the molecules in the special silk fibers. This work provides a promising solution for imaging of scaffolds in a noninvasive, high-resolution, 3D, and real-time manner.

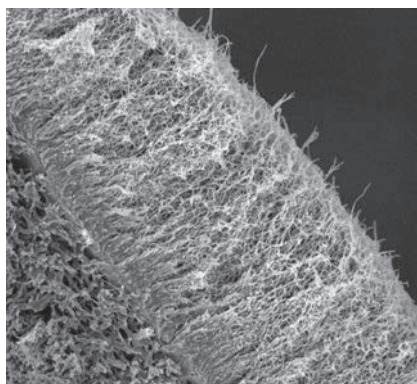


Photoluminescence Switching

N. B. Lin, X. Y. Liu,* Y. Y. Diao,
H. Y. Xu,* C. Y. Chen, X. H. Ouyang,
H. Z. Yang, W. Ji361–368

Switching on Fluorescent Emission by Molecular Recognition and Aggregation Dissociation

The dynamic self-assembly between negatively charged polyelectrolytes and positively charged peptide amphiphiles results in the formation of a hierarchically ordered membrane at the interface between two solutions. The superposition of an external electric field with the self-assembly forces can be used to control the material's growth rate, structure, and elastic properties.

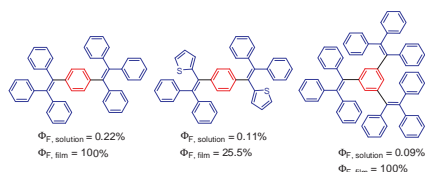


Self-Assembly

Y. S. Velichko, J. R. Mantei, R. Bitton,
D. Carvajal, K. R. Shull,
S. I. Stupp*369–377

Electric Field Controlled Self-Assembly of Hierarchically Ordered Membranes

Benzene-cored luminogens with multiple triarylvinyl units exhibit aggregation-induced emission. The high solid-state fluorescence quantum yields and high thermal and morphological stabilities of such emitters gave light-emitting diodes with sky-blue to greenish-blue light in high luminance and efficiencies. The emission can be quenched exponentially by picric acid, or selectively by Ru^{3+} , making them highly sensitive (and selective) chemosensors for explosives and metal ions.



Organic Light-Emitting Diodes

C. Y. K. Chan, Z. Zhao, J. W. Y. Lam,
J. Liu, S. Chen, P. Lu, F. Mahtab,
X. Chen, H. H. Y. Sung, H. S. Kwok,
Y. Ma, I. D. Williams, K. S. Wong,
B. Z. Tang*378–389

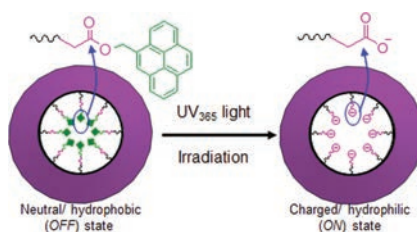
Efficient Light Emitters in the Solid State: Synthesis, Aggregation-Induced Emission, Electroluminescence, and Sensory Properties of Luminogens with Benzene Cores and Multiple Triarylvinyl Peripherals

FULL PAPERS

Nanostructures

M. Ali,* S. Nasir, P. Ramirez, I. Ahmed,
Q. H. Nguyen, L.J. Fruk, S. Mafe,
W. Ensinger.....390–396

Optical Gating of Photosensitive Synthetic Ion Channels



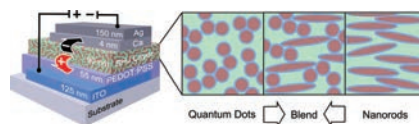
Synthetic ion channels modified with photosensitive moieties exhibit UV light-controlled ionic transport. Upon UV light irradiation the inner environment of the nanochannel is switched from a hydrophobic nonconducting (off) state to a hydrophilic conducting (on) state, allowing for the permselective transport of ionic species.

Solar Cells

K. F. Jeltsch, M. Schädel,
J.-B. Bonekamp, P. Niyamakom,
F. Rauscher, H. W. A. Lademann,
I. Dumsch, S. Allard,
U. Scherf, K. Meerholz*.....397–404

Efficiency Enhanced Hybrid Solar Cells Using a Blend of Quantum Dots and Nanorods

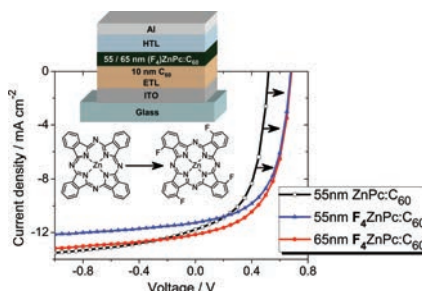
The performance of hybrid solar cells based on CdSe nanocrystals incorporated into a polymer matrix is enhanced by using a blend of spherical quantum dots and elongated nanorods. Short-circuit current and power conversion efficiency peak for a certain blend composition compared to the respective single acceptor devices, which is attributed to an improved inorganic network providing better percolation pathways for electrons. High power conversion efficiencies of up to 3.6% are achieved.



Solar Cells

J. Meiss, A. Merten, M. Hein,
C. Schuenemann, S. Schäfer, M. Tietze,
C. Uhrich, M. Pfeiffer, K. Leo,
M. Riede*.....405–414

Fluorinated Zinc Phthalocyanine as Donor for Efficient Vacuum-Deposited Organic Solar Cells

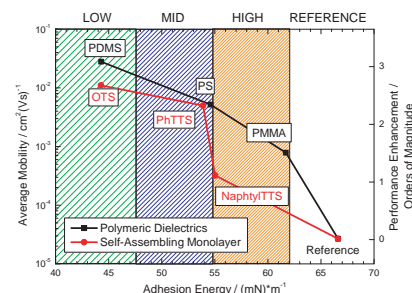


Organic solar cells with bulk heterojunctions of C₆₀ as acceptor and either zinc phthalocyanine (ZnPc), or fluorinated ZnPc (F₄ZnPc) as donor materials are presented. Substrate heating of F₄ZnPc:C₆₀ devices during film deposition strongly increases fill factor and photocurrent. Furthermore, the replacement of ZnPc by F₄ZnPc in otherwise identical devices leads to an improvement of open circuit voltage of 30%, increasing the efficiency from 3.3% (ZnPc:C₆₀) to 4.6% (F₄ZnPc:C₆₀).

Organic Thin-Film Transistors

C. Effertz,* S. Lahme, P. Schulz,
I. Segger, M. Wuttig, A. Classen,
C. Bolm.....415–420

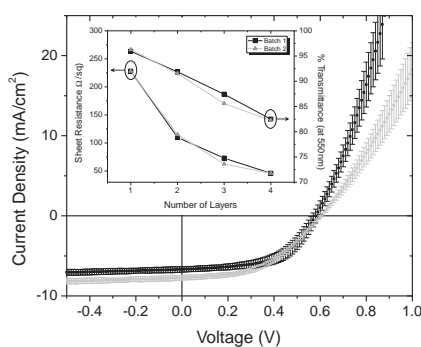
Design of Novel Dielectric Surface Modifications for Perylene Thin-Film Transistors



Dielectric surface modifications can improve the performance of organic thin-film transistors (OTFTs) significantly. Devices utilizing tailored dielectric surface modifications based on polymers and trichlorosilane-terminated self-assembled monolayers have been produced. The application of these novel dielectric surface modifications facilitates perylene thin-films with a superior film quality and high-performance perylene based OTFTs with a high charge-carrier mobility.

FULL PAPERS

Highly conductive and transparent poly-(3,4-ethylenedioxythiophene):poly(styrenesulfonic acid)PEDOT:PSS films have been prepared for stretchable and transparent electrodes. These films are shown to be reversibly stretchable over 5000 cycles of 0 to 10% strain. Using multilayer PEDOT:PSS films as anodes, indium tin oxide (ITO)-free organic photovoltaics are prepared and shown to have power conversion efficiencies comparable to that of devices with ITO as the anode.

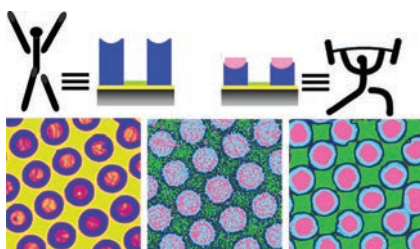


Solar Cells

M. Vosgueritchian, D. J. Lipomi,
Z. Bao*421–428

Highly Conductive and Transparent PEDOT:PSS Films with a Fluorosurfactant for Stretchable and Flexible Transparent Electrodes

Patterned, stimulus-responsive, “egg-cup”-shaped polymer brush microstructures can be used as motor arrays to manipulate the movement of gold nanoparticle (NP) aggregates in response to external stimuli that induce a conformational change in the brushes as the driving force. The motion of NP aggregates in the out-of-plane direction was achieved with displacements ranging from nanometers to sub-micrometers.

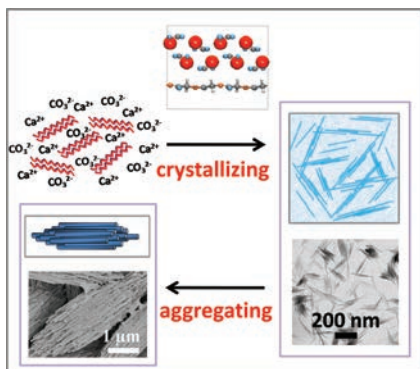


Micromechanical Systems

T. Chen,* D. P. Chang, J. Zhang,
R. Jordan,* S. Zauscher*429–434

Manipulating the Motion of Gold Aggregates Using Stimulus-Responsive Patterned Polymer Brushes as a Motor

Under controlled conditions, silk fibroin (SF) can be made to fold into regular β -sheets in an aqueous environment, and β -strand conformers can perfectly match the ionic spacing in the aragonite (010) plane, promoting growth along the (001) long axis of aragonite crystals. Further aggregation of nanoneedles leads to the formation of aragonite/SF hybrids.



Biomaterialization

T. Wang, D. Porter,
Z. Shao*435–441

The Intrinsic Ability of Silk Fibroin to Direct the Formation of Diverse Aragonite Aggregates