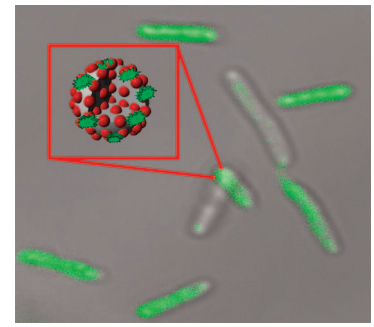
A Better Bacteriocide? Say Yes to NO

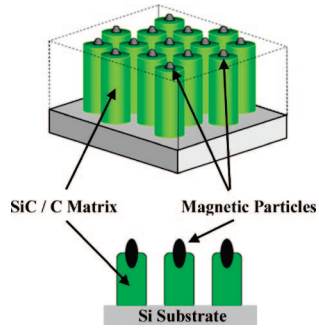
Antibiotic-resistant bacteria are the most common cause of infectious-related deaths. Consequently, new antibacterial therapeutics are needed to fight this growing threat to health and to stem the economic burden it causes. Researchers have experimented with engineering nanoparticles as delivery vehicles for antibiotics, and studies have shown that these therapeutic nanoparticles are sometimes more effective at killing bacteria than administering the antibiotic alone. However, in cases where bacteria have developed a resistance to conventional antibiotics, these antibiotic-carrying nanoparticles are of little use. Developing a new paradigm, Hetrick *et al.* (p 235) suggest that nitric oxide (NO), a diatomic free radical that the immune system already relies on to fight infections, could be an effective addition to the therapeutic nanoparticle arsenal.

The researchers produced nanoparticles with NO-release ability by incorporating diazeniumdiolate NO donors into aminoalkoxysilane precursors. Comparing these particles to a small molecule designed to release NO, Hetrick and colleagues found that the nanoparticles released their NO payload more slowly and steadily, a trait that could allow the particles to retain their bactericidal qualities as they travel through the body. The team tested their nanoparticles against *Pseudomonas aeruginosa*, a common cause of burn wound infections and foot and leg ulcers, and found them significantly more effective by weight than the small-molecule NO releaser. Though the nanoparticles proved to be effective bacterial killers, further experiments showed little harm to healthy mammalian cells. The researchers suggest that such NO-releasing nanoparticles could hold a new and untapped strategy for battling bacterial infection.



New Kid on the Block for Magnetic Thin Films

Block copolymers have the unique ability to phase-separate spontaneously into well-ordered nanoscale domains. As such, they have been demonstrated as a possible bottom-up approach for fabricating high-density periodic arrays, with potential applications in data storage and microelectronics. In much of the research in this area, the role of the block copolymer has been wholly sacrificial, acting as a template or a resist to augment traditional lithographic patterning. The use of functional block copolymers to directly create a pattern of a nanomaterial of interest is much less common but would have the advantage of fewer processing steps, thereby increasing efficiency.



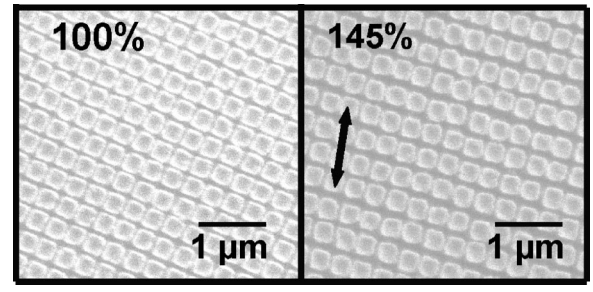
Seeking to redefine how block copolymers are used to create such arrays, Rider *et al.* (p 263) investigated the ability of cylinder-forming polystyrene-*block*-poly(ferrocenylethylmethylsilane) (PS-*b*-PFEMS) to act as both a template and a producer of inorganic nanoparticles from its constitutive elements. The team used a simple pyrolysis procedure on bulk samples of PS-*b*-PFEMS, which serves to reduce the ferrocenyl units to their elemental state and produces a structure composed of Fe nanoparticles surrounded by an amorphous cross-linked SiC/C matrix.

In further experiments involving thin films of PS-*b*-PFEMS, the researchers found that exposure to UV light effectively cross-links the PS matrix, stabilizing these samples during subsequent pyrolysis and resulting in ordered hexagonal arrays of Fe nanoparticles. These thin films exhibit magnetic effects which increase with the size of the nanoparticles. The authors suggest that this approach could offer a promising pathway for generating high-density technologies.

Printing a Solution for Surface-Enhanced Raman Spectroscopy

Surface-enhanced Raman spectroscopy (SERS) is able to provide detailed structural information with high selectivity and sensitivity, sometimes great enough to deliver information at the single-molecule level. A noble metal substrate is critical to SERS, and several groups have achieved results using substrates such as metal colloidal films, metal island films on glass, and electrochemically roughened silver electrodes. However, these surfaces are often not heterogeneous and can cause variability from one experiment to the next. Preparing more uniform and controllable SERS substrates is possible using electron beam lithography (EBL) along with reactive ion etching to hone the substrates' periodicity, shape, and spacing, but these techniques are costly and can be difficult to scale-up.

Seeking a new method to create reliable and cost-effective substrates for SERS, Abu Hatab *et al.* (p 387) combined EBL with nanotransfer printing (nTP), a high-resolution stamping technique that involves transferring material from relief features on a stamp or mold to a substrate. The team created stamps with periodic arrays of square, triangular, and elliptical pillars using EBL and then used these stamps to imprint nanopatterns of silver disks onto poly(dimethylsiloxane) (PDMS). The technique successfully created nanocomposite substrates with regular periodic morphologies that demonstrated good sensitivity in SERS tests. By pushing or pulling on the PDMS background, the team found that these substrates could be physically manipulated after printing to change the internanodisk spacing. The authors note that this method, which allows the stamp to be reused, could overcome the drawbacks of other techniques to create reproducible useful SERS substrates.



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