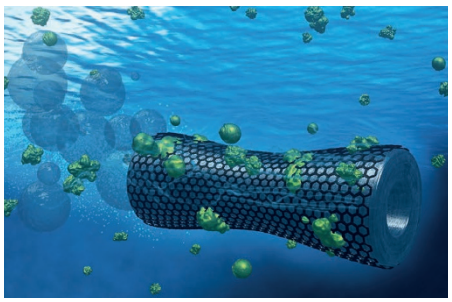
WATER TREATMENT

Submarine microbots

Nano Lett. **16,** 2860–2866 (2016)



AMERICAN CHEMICAL SOCIETY

Recent advances in nanotechnology have led to novel ways of dealing with environmental pollution, especially for water contaminated by heavy metals. Self-propelled, micro-scaled motors based on multifunctional materials promise better performances than more traditional filtering strategies. However, the environmental cost of these approaches is severely affected by the inability to reuse the same microbots for repeated cleaning cycles.

Now, Diana Vilela who is based at the Max Planck Institute for Intelligent Systems in Stuttgart and colleagues from Spain and Singapore have reported graphene-based, reusable microbots for the removal of heavy metal ions from water. The microbots have a three-layered tube structure of platinum, nickel and graphene oxide. The active graphene oxide outer layer adsorbs lead (II) ions, which crucially can then be removed in acidic solution, allowing the microbots to be reused without compromising their structure and adsorption efficiency.

Vilela and co-workers also demonstrated that lead adsorption is dramatically increased by allowing the microbots to swim in the liquid. The platinum-based inner layer catalyses the decomposition of hydrogen peroxide, forming oxygen bubbles, which propel the microbots forward. The nickel-based middle layer is ferromagnetic, allowing the removal of the microbots from the water following decontamination, and making it possible to guide their movement direction by external magnetic fields. *GP*

ARTIFICIAL CELLS

Pressurize and release

Langmuir **32,** 3794–3802 (2016)

Microtubules — the cell's cytoskeleton formed through the polymerization of tubulin proteins — are important for cell morphogenesis, movement and protein transport. Tubulin has been encapsulated in giant liposomes and shown to polymerize and form protrusions similar to those produced by living cells. However, repeated and controlled formation of these protrusions has not been possible. Researchers in Japan now report that applying hydrostatic pressure can reversibly and repeatedly alter the polymerization and depolymerization of microtubules inside liposomes, forming artificial motile cell models for molecular robotics.

Kingo Takiguchi and co-workers — from Nagoya University, Kyoto University and the University of Tokyo — encapsulated tubulin inside giant liposomes and used microscopy to monitor the morphological changes at different hydrostatic pressures. At ambient pressure (0.1 MPa), tubulin was seen to polymerize, elongate and push the liposomal membrane outward to form protrusions. When the pressure was increased to 60 MPa, the protrusions shortened rapidly but were regenerated at the same location within several minutes of the pressure being released. This process was induced several times, suggesting that microtubules are sensitive to hydrostatic pressure and reversible deformation can be exploited to control their polymerization state. *ALC*

SUPRAMOLECULAR CATALYSIS

Chirality amped up

J. Am. Chem. Soc. **138,** 4908–4916 (2016)

Asymmetric catalysis is usually performed using small organometallic complexes with enantiopure ligands. Much rarer, however, are catalysts that use chiral amplification, where a small chiral bias is translated into a large conformational preference. This amplification process is believed to be fundamental to the origin of homochirality, a topic that is still poorly understood. Now, Matthieu Raynal and colleagues at CNRS at the Sorbonne, along with collaborators in Toulouse and Spain, have shown that enantioinduction can be achieved in chirally amplified supramolecular helical catalysts.

The helices are self-assembled from benzene-1,3,5-tricarboxamides (BTA). By mixing achiral BTA phosphine ligands and enantiopure BTA amino acid derivatives, the researchers showed that efficient chirality transfer occurs with just 25% of the chiral monomer. The transfer of stereochemical information is propagated from the amino acid side chains, through the hydrogen-bonded helical assembly, to a peripheral rhodium centre, which in turn catalyses an asymmetric hydrogenation reaction with high enantioselectivity (85% ee). The screw sense (handedness) of the helix directs the stereoselectivity of the catalytic reaction, so both enantiomers of the product can be achieved simply by inverting the amino acid stereochemistry in the BTA comonomer. This illustrates that the 'sergeants and soldiers' effect can be efficiently utilized in asymmetric catalysis. Surprisingly, at higher chiral comonomer concentrations, the enantioinduction actually decreases as the coordination of rhodium by two adjacent phosphine monomers is prevented. *BLB*

BIOMIMETIC CATALYSIS

Fuel to fuel

Angew. Chem. Int. Ed. http://doi.org/f3mb4c (2016)

Cells generate energy by coupling a proton gradient across a phospholipid bilayer with a membrane-spanning ATP synthase enzyme. In an effort to mimic this process in an artificial environment, Marisela Vélez, Antonio De Lacey, Iván López-Montero and colleagues now show that ATP can be efficiently produced by using molecular hydrogen as a fuel.

The researchers, who are based at the Spanish National Research Council, the Universidad Complutense de Madrid and the Universidade Nova de Lisboa, designed a biomimetic system with a hydrogenase catalyst bound to a gold surface, on top of which is deposited a membrane bilayer containing ATP synthase. Under a small voltage bias, hydrogen from solution gets oxidized, thus forming a proton gradient across the phospholipid membrane. This gradient, which can be as large as 1 pH unit, drives the conversion of ADP to ATP by reaction with a phosphate ion from solution.

The system developed by Vélez and co-workers is reversible (where the ATP synthase generates a proton gradient by converting ATP to ADP and phosphate ions) and has a turnover rate around an order of magnitude higher than that found in analogous biomimetic systems that use other means, such as light, to create the proton gradient. *AM*

Written by Ai Lin Chun, Bryden Le Bailly, Alberto Moscatelli and Giacomo Prando.