Heart twists

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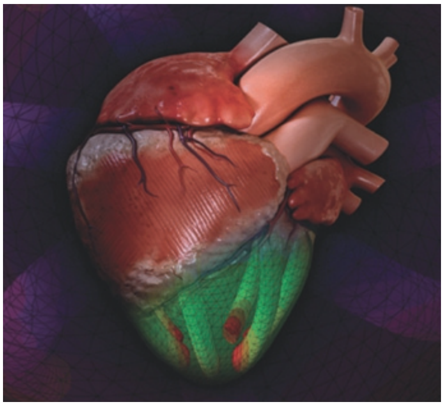

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Pneumatic artificial muscles (PAMs) are robust and flexible 'bladders' that can contract when inflated with pressurized air. Because of the simple fabrication methods and their fast response, they are widely used as actuators in robotics and automation. Now Ellen Roche and co-workers assemble arrays of millimetre-sized PAMs in elastomeric matrices to create artificial soft muscular tissues, and demonstrate that these systems can perfectly mimic the complex motion of a human heart. In a three-dimensional mould of a left ventricle, they positioned thin actuators similar to the arrangement of muscle fibres, and embedded them in a polymer layer that has an elastic modulus comparable to that of myocardial tissues. This prototype was able to reproduce the twisting of a healthy ventricle, as well as the abnormal movements induced by partially damaged heart muscles. The application of these soft actuators in artificial organs may require further investigation; however, the researchers suggest that these prototypes could be used as simulators to re-create a heart environment in which the reliability of implantable prosthetic devices, such as valves, can be tested. *LM*

Fatigued metallic glasses

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Despite being substantially more resistant to plastic deformation than crystalline metals, metallic glasses are rarely used as structural materials because of their high susceptibility to fatigue. Indeed, because glasses lack the typical obstructions to crack propagation that crystalline materials have (such as microstructural defects or grain boundaries), relatively low cyclic stresses can cause small cracks to propagate within the material. Cheng-Cai Wang and colleagues now provide real-time insights into the fatigue cracking at room temperature of notched metallic microbeams inside a high-resolution transmission electron microscope. They show that with increasing strain cycles the surface of the notches roughens through the formation of nanoscale intrusions and extrusions that act as crack-nucleation sites (which is analogous to surface roughening in crystalline metals), and that enhanced atomic diffusion in regions of high deformation (such as near crack tips) causes the formation, growth and coalescence of nanocrystals, which can provide resistance to crack propagation. Monotonically strained samples show instead smoother notch surfaces and smaller nanocrystals. *PP*

Improved by integration

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Radiolabelled nanoparticles for use as imaging agents in positron emission tomography (PET) usually rely on macrocyclic chelators to attach the radiolabels, for example ^{64}Cu, to the nanoparticles. This arrangement can easily dissociate *in vivo*, however, resulting in reduced diagnostic accuracy. Now, Zhao *et al.* report an improvement in the radiolabel stability of ^{64}Cu-doped gold nanoparticles by the direct incorporation of ^{64}Cu into the lattice structure of the nanoparticles ($^{64}CuAuNPs$). The $^{64}CuAuNPs$, prepared using $^{64}CuCl_2$ as a precursor, have ^{64}Cu integrated throughout and their activity can be controlled by altering the initial activity of $^{64}CuCl_2$. In a cancer mouse model, Zhao *et al.* use PET imaging to show that the $^{64}CuAuNPs$ passively target and heterogeneously distribute within the tumour. *In vivo* pharmacokinetic studies indicate that most of the $^{64}CuAuNPs$ are retained within systemic circulation at 1 hour, but are rapidly cleared by the liver and spleen at 24 hours. These factors result in accumulative uptake in the tumour and an increased tumour-to-muscle ratio at extended PET imaging times. *AS*

Rough with the smooth

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Invisibility cloaks that guide light around three-dimensional objects have captured the attention of scientists, but their practical realizations have been hard to come by. The reason for this is because of the various limitations and complexities in the material properties required to implement them in devices. Now, Yang Hao and colleagues propose an appealing strategy for realizing cloaks for surface waves, which in practice means that waves propagating on a curved, bumpy surface appear to be travelling on a flat surface instead. Their key idea is to cover the surface with a thin coating characterized by a refractive index that varies according to the position of the wave on the curved surface. In this way, the cloaks can be shown to be omnidirectional and able to conceal large objects without resorting to complex material properties. All of which may have interesting implications for devices relying on electromagnetic surface waves. *AT*

Anhydrous polymer electrolyte

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Although proton exchange membrane (PEM) fuel cells are widely considered as technologically promising for next-generation electrical vehicles, they operate in a limited temperature range (typically around 60–80 °C), which requires expensive platinum catalysts. Using low-cost oxide-based catalysts would be practically advantageous for applications but this would involve designing PEM fuel cells that could function above 100 °C under low-humidity conditions. Meilin Liu and colleagues now report a family of tetrazole-based polymer electrolyte membranes that exhibit high proton conductivity over the temperature range 20–120 °C in low humidity. The PEMs are also stable over a wide potential range and exhibit electrochemical stability under harsh fuel-cell operating conditions. The authors believe that this class of membranes could simplify fuel-cell systems and lead to the development of fuel cells for zero-emission vehicles. They could also be suitable for small microelectronics devices that require fuel cells to be operable over a wide temperature range without bulky and complicated thermal-and water-management systems. *VD*

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