NANOFABRICATION

Porous hierarchy

Sci. Adv. **4**, eaas9459 (2018)

Credit: AAAS

Metal nanoporous structures combine good electrical and mass transport with high surface area to volume ratio, which makes them promising for supercapacitors and catalysis applications. Such structures can be obtained by de-alloying binary metallic alloys. For example, nanoporous gold is often created by dissolution of silver from a silver–gold alloy. Despite encouraging results obtained in the past, a limitation of nanoporous gold is that the pore structure is usually fairly random and generates considerable resistance to mass flow.

Now, Cheng Zhu et al. have fabricated hierarchical nanoporous gold by the combination of 3D printing with alloying and de-alloying. Large macroscopic pores, of the order of micrometres or even tens of micrometres, can be used as preferential channels for mass transport, while a finer structure of pores in the tens of nanometres range ensures a high surface to volume ratio. The first step of the fabrication process is the 3D printing of a porous macrostructure of gold and silver microparticles, which is then annealed to form a homogeneous Au–Ag alloy. Eventually, the alloy is immersed in an etching agent that removes the silver, leaving a porous nanostructure with typical features in the 10–100 nm range.

The hierarchical non-porous structure substantially outperforms its non-hierarchical analogue in terms of electrochemical, mass-transport and catalytic properties. *FP*

https://doi.org/10.1038/s41565-018-0311-z

SUPERCONDUCTIVITY

A furled superconductor

Nano Lett. https://doi.org/gfd3d8 (2018)

Superconductivity in reduced dimensions is prone to effects not present in bulk superconductors. Somewhat surprisingly, Feng Qin et al. now show that the critical temperature of superconducting WS_2 nanotubes decreases with the diameter.

The researchers intercalated potassium in individual multiwall WS_2 nanotubes to make them superconducting and determined the critical temperature of the nanotubes. They also measured the conductance through the tubes as a function of magnetic field. If the field is applied parallel to the tube, a supercurrent flows along the tube's circumference and produces quantum interference. The interference creates oscillations in the resistance with increasing magnetic field and enables a determination of the effective tube diameter. Although the critical temperature appears to be independent of the wall thickness, it scales linearly with the inverse diameter of the tube. This result comes as a surprise; for carbon nanotubes, theory had predicted an increasing electron–phonon coupling with shrinking diameter, which should augment the critical temperature. Qin et al. now speculate that the observed decrease in critical temperature for WS_2 is linked to lattice distortions in the tubes, which could yield unconventional electron–phonon interactions. *BH*

https://doi.org/10.1038/s41565-018-0309-6

CANCER

Inhibiting collective cell migration

ACS Nano **12**, 9279–9290 (2018)

Collective cell migration, the motion of entire groups of cells as a single unit, occurs in development and in cancer metastasis. This behaviour arises from communications between cells — mediated by cadherins — and between cells and their environment — mediated by actins and integrins. Disrupting these communication pathways might provide a way to limit cancer metastasis. Integrin-targeted gold nanorods coupled with near-infrared irradiation have been used to achieve this goal, but the mechanisms underlying the effect have remained poorly understood.

Using mass spectroscopy-based phosphoproteomic analyses, Wu et al. now show that the above treatment induces variation in the phosphorylation pattern of key signalling proteins involved in cell adhesion and actin organization. This results in morphological changes of the actin filaments in the cytoskeleton, particularly at the cell junction. The authors observe a concomitant decrease in the expression level of proteins involved in cell–cell adhesion, such as N-cadherin and the tight junction protein ZO-2. *CP*

https://doi.org/10.1038/s41565-018-0310-0

MESOPOROUS MATERIALS

Proteins aggregate not

J. Am. Chem. Soc. **140**, 12720–12723 (2018)

Inside cells, proteins may be found in crowded solution, at high concentrations or immobilized on surfaces, without losing their activity. In contrast, in highly concentrated bulk solutions, proteins tend to aggregate and crash out. This is the case, for example, for myoglobin and lysozyme, two small proteins whose activity in the cytoplasm of a cell is controlled through their interaction with a chaperonin for proper folding and unfolding. Now, Siefker et al. have shown that aggregation of both myoglobin and lysozyme is also prevented inside the pores of two mesoporous silica materials, SBA-15 and KIT-6.

The researchers load their mesoporous silica with either protein at increasing concentrations and carry out small-angle neutron scattering experiments. At low loading, the scattering signals are indistinguishable from those of the unloaded silica. Because of low signal contrast, the presence of a small amount of protein cannot be reliably distinguished from the roughness of the pore walls. However, at high loading, high enough to approach the maximum packing density of the proteins, a broad feature starts to appear in the scattering spectrum that is characteristic of species showing intense, not sterically hindered, intermolecular interactions, but not aggregation. This liquid-like behaviour is due to enhanced interactions among proteins, and between the proteins and the pore walls, which promote stabilization rather than aggregation, similar to what is observed inside the cytosol. *AM*

https://doi.org/10.1038/s41565-018-0308-7

Benjamin Heinrich, Alberto Moscatelli, Chiara Pastore and Fabio Pulizzi