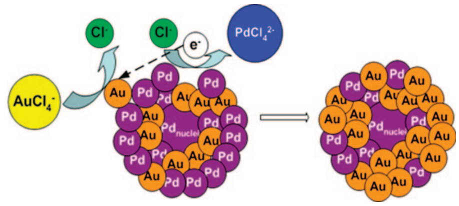
Bimetallic Nanoparticles: A Strategic Merger

Bimetallic nanoparticles (NPs), in either alloy or core–shell form, are of great interest from both scientific and technological perspectives. They have attractive physical and chemical properties that result not just from their size but from their combination of different metals. These particles frequently clump into nanoclusters composed of both alloyed and single species. Among the various bimetallic nanoclusters, Pd–Au has been widely explored as a catalytic material for a range of chemical reactions, including vinyl acetate synthesis and oxidation of alcohols to aldehydes. Chen *et al.* recently reported that the properties of bimetallic catalysts can

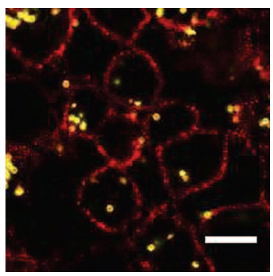


be significantly influenced by the extent of alloying between the two constituent elements, an observation they based on X-ray absorption spectroscopy (XAS). Using the same methodology in a new study (p 114), the researchers used XAS to design and to construct Pd–Au atomic stackings in water-in-oil microemulsions by employing hydrazine reduction reactions together with redox transmetalation reactions.

Using *in situ* XAS, Chen and colleagues confirmed that Pd–Au clusters follow a characteristic pattern of stacking. They were able to fine-tune the thickness of each stacked layer by varying the dosage of Au precursor, Pd, and hydrazine, with results suggesting that they could also control the surface composition of Pd and Au in the NPs. The researchers note that, by modifying the stacked layers with other metals or using other bimetallic NPs, other constructs can be assembled for a variety of interesting applications.

Tiny Magic Bullets To Fight Cancer

Nanoscale polymer capsules have been proposed as an innovative new way to deliver targeted therapeutics for cancer. Such capsules can be loaded with a wide variety of materials, such as proteins, drugs, and nucleic acids, and their tiny size allows them to be taken up inside of cells to deliver this payload. In a previous study, Cortez *et al.* coated the surfaces of polymer core–shell particles and capsules with huA33 monoclonal antibodies. These antibodies bind specifically to the A33 antigen present on most colorectal cancer cells. Though the technique increased specific binding 4-fold compared with that of unfunctionalized particles, the researchers sought to determine ways to push specific binding even higher.

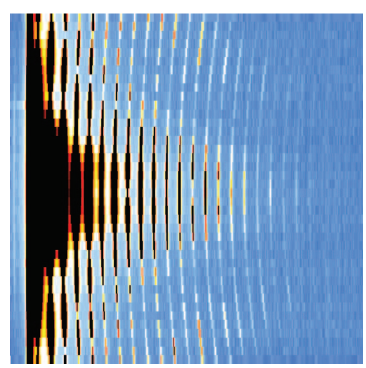


In a new study (p 93), Cortez *et al.* investigated the influence of a number of factors that might affect specific binding of antibody-coated nanoparticles to colorectal cancer cells, including size, surface properties, cell line, particle concentration, and incubation time. The team found that the ideal size for these nanoparticles to specifically bind to cells appears to be around 500 nm, with particles bigger or smaller not binding to the targeted cells as efficiently. Coating the nanoparticles with a negatively charged polymer and delivering a high dose of nanoparticles served to reduce nonspecific binding. Cell line identity appeared to make no difference for binding, with antibody-coated nanoparticles binding equally well to colorectal cancer cells of two different lineages that exhibit the target antigen. The researchers note that their study paves the way for further *in vitro* and *in vivo* studies of therapeutic drug loading and release from nanoscale multilayer capsules.

Learning To Relax in Nanoimprint Lithography

Nanoimprint lithography (NIL), a next-generation alternative to the commonly used optical lithography, is quickly gaining in popularity. This technique is a type of contact lithography where the pattern transfers from a rigid mold to a liquid/melt resist through one of two typical approaches: ultraviolet radiation-induced cross-linking or thermal embossing. An advantage of thermal embossing NIL over other lithographic patterning techniques is its capability to pattern a wide range of polymeric materials and to imprint at a very small scale; patterns with sub-10-nm features have been successfully fabricated using this technique. However, despite its benefits, quantifying pattern stability or shape changes due to internal stresses is a challenge in nanoscale patterning.

In order to study the real-time kinetics of decay in thermally annealed imprinted polymer grating patterns, Ding *et al.* used a simple laser diffraction technique (p 84). The researchers found a distinctive anomaly in diffraction intensity during the annealing of these gratings with tall lines, explaining this unusual finding as a resonance effect due to the interaction of the light with certain shapes and heights of the grating lines. Allowing it to serve as a characteristic time scale to analyze the pattern decay, the researchers found that the decay rate shifts to shorter time with increasing annealing temperature. The molecular weight of polystyrene used to make the patterns had a significant effect on their stability. For example, patterns made from PS30k decayed like a simple



Newtonian fluid, but for PS1800k, the relaxation of residual stresses significantly enhanced pattern decay. The researchers note that further studies using this technique could shed additional light on decay that occurs with the imprinting process.

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