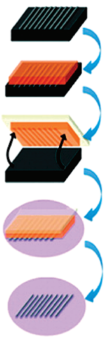
Golden Stamp of Approval for Transfer-Printing Graphene

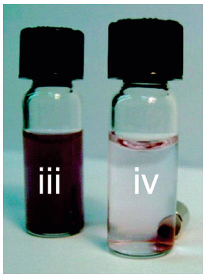
Graphene's high electron mobility and other interesting properties have attracted increasing attention from both fundamental and application-oriented communities. Researchers have sought to manufacture graphene by exfoliation of highly oriented pyrolytic graphite (HOPG) using a variety of methods. However, manipulating and transferring graphene on a large scale still presents numerous challenges.

Drawing on recent reports of strong attractions between gold and carbon nanotubes, Song *et al.* (p 1353) tested the use of gold film as a transfer stamp to exfoliate prefabricated graphene patterns from HOPG surfaces. The researchers first patterned micrometer-scale line features of different sizes onto HOPG disks using photolithographic techniques followed by oxygen plasma etching. Next, they deposited gold film onto the disks and used thermal releasing tape to peel off the film along with the graphene patterns. These tapes were then pressed onto various preheated target substrates, allowing the thermal tape to release the gold film along with the patterned graphene. Once the gold was etched away, large areas of patterned graphene remained on the substrates. The researchers suggest that this method could serve as a new approach for printing graphene electrical circuits on large scales.



Magnetic Nanoparticles Get the Golden Touch

Interest continues to grow in developing hybrid nanoparticles that combine multiple functions or properties not achievable for individual materials. One particular focus is the fabrication of new nanomaterials that incorporate an optical signature, useful for tracking or monitoring particles, with other physical properties. Integrating noble metals such as Au, with its strongly localized surface plasmons, is one way to achieve this goal. An added benefit is that the Au surface can be chemically functionalized to enhance solubility or biocompatibility.

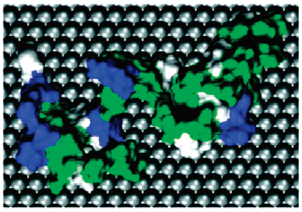


Using this method, Levin *et al.* (p 1379) merged optical and magnetic properties by creating wüstite (Fe$_x$O) nanocrystals wrapped in continuous Au shell layers. The large core sizes of the synthesized nanoparticles and thick Au shell layers (from 11 to 45 nm) produce a prominent surface plasmon peak, tunable to longer wavelengths as the shell thickness increases. Using permanent magnets, the researchers show that the particles are drawn to the magnets when in solution, retaining their magnetic properties even with a complete, continuous Au coating. The authors suggest that combined gold-ferrimagnetic particles such as theirs could have numerous applications, including in biomedical uses, separation processes, and as magnetic resonance imaging contrast agents.

Gold and the Peptides That Bind

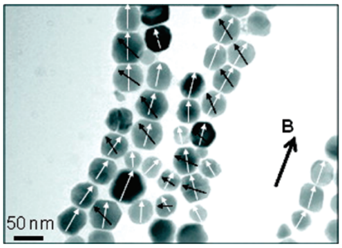
Recently, researchers have taken advantage of the structural and chemical diversity of amino acids to discover sequences with desired material specificity for use in technology and medicine. A crucial factor in enabling the application of these materials is to understand the mechanisms by which protein sequences interface with specific solid surfaces. To study this phenomenon, some investigators have exploited combinatorial genetic techniques, which permit isolation of specific recognition elements for surfaces, including those not recognized by naturally occurring amino acid sequences.

So *et al.* (p 1525) employ this tool in a new study by focusing on the so-called 3GBP$_1$ peptide, a Au-binding peptide with a specific amino acid sequence repeated three times to enhance its binding affinity. Using a variety of techniques, including high-resolution atomic force microscopy, molecular simulation, and geometrical docking studies that detail the peptide's formation, the researchers studied how 3BP$_1$ adsorbed to Au surfaces, confirming the intrinsic disorder of the peptide and identifying putative Au docking sites where surface-exposed side chains align with particular Miller indices of the Au lattice. The authors suggest that these surface-binding studies provide new insight into biological molecules that bind specific inorganic materials, providing a basis for novel hybrid molecular technologies such as protein chips and designer proteins.



Understanding the Pull of Magnetic Anisotropy

Researchers have long known that aligning nanoparticles gives rise to magnetic anisotropy or a directional preference for a magnetic field applied parallel to the direction of the alignment than for a magnetic field applied perpendicular to this direction. Explaining the origin of this phenomenon continues to challenge investigators in this field, as does differentiating between the influence of the nanocrystal preferred (*i.e.*, easy axis) alignment and the dipolar interactions induced by the ordering of the nanocrystals.



To investigate nanocrystal magnetic anisotropy further, Alphandéry *et al.* (p 1539) studied biologically synthesized iron oxide nanoparticles, called magnetosomes, produced by AMB-1 magnetotactic bacteria. These nanocrystals are arranged in chains inside the bacteria, creating a strong dipole that the microbes use to align and to swim along the earth's magnetic field. The researchers worked with two types of extracted magnetosomes: those connected by biological filaments, which maintain the alignment of easy axes, and those lacking filaments with randomly distributed easy axes. When the responses of both populations in magnetic fields were investigated, results show that magnetic anisotropy in these nanocrystals arises mainly from dipole interactions between them and, to a smaller extent, the alignment of their easy axes. This fundamental finding could help lead to applications, such as magnetic recordings, the researchers suggest.

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