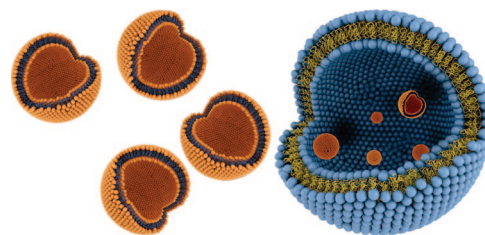


## "Vesosomes" Put Many into One

■ Conventional unilamellar vesicles used in drug delivery and as cell models have a single compartment delimited by a single lipid bilayer membrane, which defines the interior space, regulates release of the vesicle contents, and protects the vesicle contents from degradation. Such liposomes mimic the single-compartment structure of a prokaryote cell. Despite the utility of this design, which is already used for delivery of some drugs, single-layer liposomes can allow contents to leak too rapidly in a physiological environment, causing drugs to be released too quickly to be effective. Seeking a way to delay drug release, Boyer and Zasadzinski (p 176)

developed a new structure that more closely mimics the multi-compartment organization of a eukaryotic cell. This novel design, which the researchers call a "vesosome", consists of several unilamellar liposomes enclosed within another liposome.

To test whether their design effectively slows the release of components trapped inside, the researchers enclosed a fluorescent material inside liposomes and then wrapped multiple liposomes inside a second lipid layer. They then exposed these vesosomes to lipases and serum to mimic harsh physiological environments. The vesosomes retained their contents in these solutions

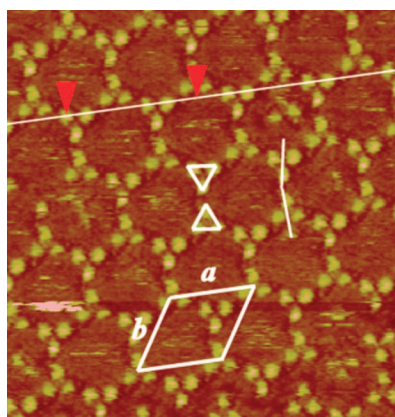


more than twice as long as single-layer liposomes. The researchers note that varying the composition of the internal membranes of the vesosomes could further optimize content retention. In addition, this multicompartimental design could eventually offer the flexibility of delivering more than one drug inside a single carrier.

## Oligofluorenes: Stars of Self-Assembly

■ Well-defined conjugated oligomers have precise chemical structures and physical properties that are able to define functional properties and facilitate enhanced control over their supramolecular structure. These qualities make them likely to play a crucial role in advancing molecular electronic devices. Molecular assembly on a solid surface strongly affects the properties of these devices. As such, understanding and fine-tuning the orientation and packing of  $\pi$ -conjugated oligomers in a self-assembling system are indispensable for developing future nanodevices.

To examine such properties in one variant of these molecules, Ma *et al.* (p 160) synthesized a series of three star-shaped oligofluorenes end-capped with one, two, or three carboxylic groups. Hydrogen bonding between carboxylic groups was intentionally introduced at the end of



the arms of these star-shaped molecules. Using scanning tunneling microscopy, the researchers observed these molecules assembling at the solid-liquid interface.

These observations revealed that the number of end-groups seems to have profound effects on the formation of the associated self-assembled monolayers and their patterns. With the assistance of intermolecular hydrogen bonding, the adsorbate-substrate  $\pi$ - $\pi$  interactions, and the stabilizing effect of long side chains, each of the three different molecules showed long-range ordered molecular architectures. Differences in the size of the molecules' side chains led to predictable and distinct variations in surface coverage and patterning. The authors note that developing a deeper understanding of how end-groups affect the characteristics of each molecule could lead to a better knowledge of how these molecular patterns can act as host networks for guest molecules in nonlinear optics and electric or optoelectric devices.

## Growing Nanotubes, from Tip to Root

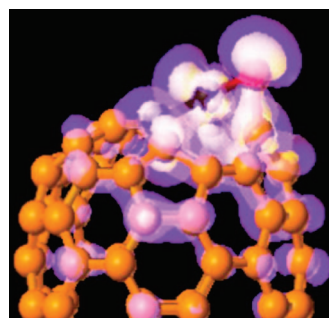
■ The formation of single-walled carbon nanotubes (SWNTs) is triggered by enriching the graphite source material with a pure population or a mixture of transition metal catalysts, such as Co, Ni, or Fe. The exact role that these metal atoms play in determining the growth of SWNTs remains controversial. Several theoretical groups have investigated the early stages of nanotube growth using different simulation techniques, which have mainly supported a root growth mechanism where carbon atoms are incorporated into the tube base by a diffusion-segregation process. Some simulations have suggested a tip growth mechanism

in which metal atoms prevent tube closure by scooting around and annealing defects, stabilizing the reactive dangling bonds, and allowing the incorporation of new carbon species.

To better understand SWNT formation at the atomic scale, Charlier *et al.* (p 202) used quantum molecular dynamic and tight-binding Monte Carlo simulations. At experimental temperatures ( $\sim 1500$  K), the simulations suggest that the catalytic Co atom incorporates into the C network instead of scooting around the open edge of the forming nanotube. Consequently, the open edge of a SWNT closes spontaneously into a graphitic

dome, suggesting a closed-end mechanism for the catalytic growth. At 1500 K, the Co-C chemical bonds keep breaking and re-forming, providing a direct incorporation process for the additional

carbon needed for growth. The catalytic action of Co atoms also seems to play a key role in reconstructing the nanotube tip after C incorporation by annealing defects. The researchers indicate that this scenario may co-



exist with the root growth mechanism shown by other groups.

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