Formation Mechanism of Columnar Nacre Proposed

Nacre, or mother-of-pearl, a composite formed by alternating sheets of organic matrix and platelets of aragonite, exhibits remarkable mechanical properties. To date, its formation mechanism had not been completely elucidated. Recently, however, P. Gilbert from the University of Wisconsin, Madison; M. Abrecht from the Synchrotron Radiation Center, Madison; D. Ariosa from the Swiss Institute of Technology, Lausanne, Switzerland; and their colleagues proposed a growth mechanism for nacre after using x-ray photoelectron emission spectromicroscopy and x-ray absorption near-edge structure (XANES) spectra to obtain information about the orientation of the nacre platelets making up the aragonite layers. Their results were published in the June 29 issue of *Physical Review Letters* (DOI: 10.1103/PhysRevLett.98.268102) and then featured in *Science* (July 13, p.175; DOI: 10.1126/science.317.5835.175d).

X-ray photoelectron emission spectroscopy, a surface-sensitive technique that enables imaging and extraction of spectroscopic information from a single layer of nacre platelets or from a polished cross section including many layers, provided carbon, oxygen, and calcium maps that, under the appropriate illumination, showed the crystallographic orientation of each nacre platelet with respect to the polarization of the x-rays. The researchers found that, whereas carbon and oxygen showed similar variations, the Ca distributions appeared completely homogeneous. The different intensities observed in those element maps were due to the different angle between the *c*-crystallographic axis for each aragonite platelet and the polarization vector of x-rays. The spectromicroscopy data showed that platelet orientation is conserved across only 1–40 layers in each column. Furthermore, the growth direction of nacre cannot be identified with the *c*-axis of the nacre platelets, as is usually assumed, because the *c*-axis is oriented differently in neighboring columns of platelets.

The researchers proposed a simple formation mechanism considering that the organic matrix sheets are formed first, with preformed randomly distributed nucleation sites. One possibility is that these nucleation sites become active at an appropriate stage of the growth process, when a STOP-active organic molecule on side n of the organic matrix sheet arrests aragonite growth for platelet n along the growth direction, while its counterpart START-active organic molecule on the side $n + 1$ of the same organic matrix sheet is activated and a new aragonite platelet $n + 1$ is nucleated. Another possibility is that the nucleation site is porous and it simply allows crystal n to grow through it to start the growth of crystal $n + 1$. The researchers said that "the resulting scenario reconciles apparently discrepant lines of evidence, and encompasses the present results and all other data currently available on the mystery of abalone nacre formation."

JOAN J. CARVAJAL

Nutrition-Driven Nanoassembly of Gold Colloid on Growing Fungi Results in Microwires

In recent years, structurally diverse forms of microorganisms have been used as templates for the fabrication of inorganic nanostructures. In most cases, attachment of nanoparticles to the micro-organism surface involves sequence-specific recogni-

https://doi.org/10.1557/mrs2007.156 Published online by Cambridge University Press