Using Viruses as Nanoscale Building Blocks

Scientific Achievement

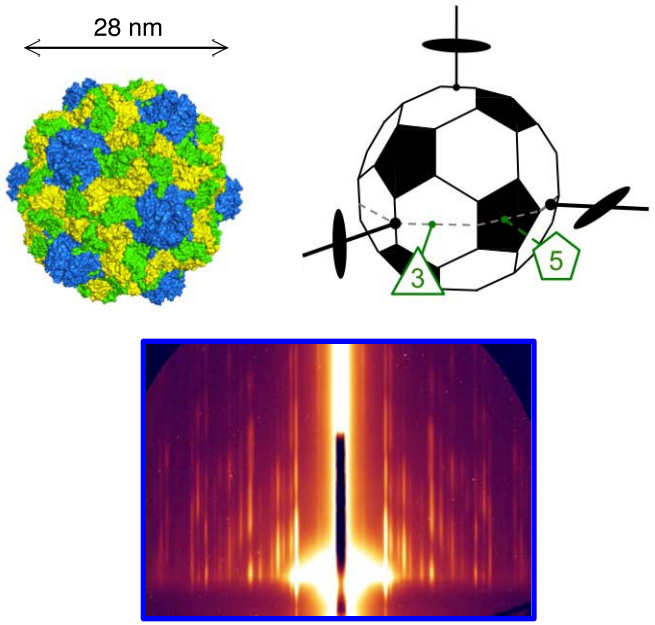
Scientists discovered structural diversity in 2D crystalline structures assembled from the outer shells of a virus.

Significance and Impact

Virus-like particles can be used as versatile building blocks for creating new nanostructures. Their exterior and interior surfaces can be modified by genetic and chemical methods, not only to make nanoscale reaction vessels and containers but also to control the assembly of these particles into complex architectures.

Research Details

- The work is unique for demonstrating a rational approach to two-dimensional crystallization based on controlling the interactions of virus particles, which occur at the surface of an aqueous solution.
- The team used as their model system the icosahedral turnip yellow mosaic virus (TYMV).
- Their discovery of two new forms of 2D crystals, distinct from previously observed hexagonal and square crystals, suggests that a variety of complex, ordered structures can be generated through self-assembly of highly symmetric, non-spherical particles.



Above: At left, the protein shell of TYMV consists of 180 copies of a protein subunit, with 60 subunits forming 12 pentamers (blue) and 120 subunits forming 20 hexamers (yellow and green). At right, the truncated icosahedron, which resembles a soccer ball, illustrates the virus orientation.
Below: Grazing-incidence small-angle x-ray scattering (GISAXS) pattern from 2D crystals of TYMV bound to a cationic lipid monolayer at the air-water interface.

M Fukuto, QL Nguyen, O Vasilyev, N Mank, CL Washington-Hughes, I Kuzmenko, A Checco, Y Mao, Q Wang, L Yang, *Soft Matter*, 2013, 9, 9633-9642

Work was performed at Brookhaven National Laboratory

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