New Classes Of Cage And Polyhedron And New Classes Of Nanotube And Nanotube With Planar Faces

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SUMMARY

UCLA researchers have developed a novel algorithm that can be used to design unique self-assembled molecules and nanostructures.

BACKGROUND

New drug discovery and drug delivery systems are relying more heavily on modelling software to clarify self-assembly in virus structures and protein folding. These models use the description and classification of geometric forms to more readily understand self-assembly. The three standard classes of convex equilateral polyhedron with polyhedral symmetry include the five Platonic solids (i.e., the tetrahedron, octahedron, and icosahedron), the 13 Archimedean solids (i.e., the truncated icosahedron with its soccer-ball shape), and the two Keplerian rhombic polyhedra. The icosahedral polyhedra resemble some carbon fullerenes, inorganic cages, icosahedral viruses, protein complexes, and geodesic structures. In drug delivery applications, these assemblies act as cages for other molecules, but the cage shapes require that the atomic bond lengths all be the same and not be twisted. These criteria limit the standard molecular cages to those just listed, which constrains the size of the molecules that can be hosted.

INNOVATION

UCLA researchers have identified a new class of convex equilateral polyhedra with polyhedral symmetry called “Goldberg polyhedra.” Unlike faceted viruses and related carbon fullerenes, the icosahedral Goldberg polyhedra are nearly spherical. The resulting Goldberg polyhedra and corresponding Goldberg cages may be used to construct an efficient and nearly spherical framework or dome wherein the edges or struts of the framework are of equal length and wherein the faces are planar. For drug delivery applications this new class of polyhedral will increase cage-size versatility. Moreover, this classification can be used in modelling software for designing self-assembled nanostructures, virus structures, protein folding, and protocells. The reasoning and techniques identified by this innovation will enable discovery of more classes of convex equilateral polyhedron with polyhedral symmetry.

APPLICATIONS

- Modeling and geometry engine software for geodesics, chemistry, and biochemistry
- Design of self-assembled molecules & nanostructures:
  - Nanocages for drug delivery
  - Protocells for synthetic biology and bioengineered proteins
  - Self-assembled DNA origami-inspired smart structures
- Easily assembled temporary housing for disaster areas
- Designs that approximate spheres (i.e. golf balls, spherical displays)

ADVANTAGES

- New class of convex equilateral polyhedra
- Increases size cage range in drug delivery applications

PATENT STATUS

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OTHER INFORMATION

KEYWORDS

algorithm, nanotubes, fullerenes, inorganic cages, icosahedral viruses, geodesic structures, protein complexes, self-assembled nanostructures, virus structures, protein folding, protocells, DNA origami, convex equilateral polyhedral, Platonic polyhedron,

CATEGORIZED AS

- **Computer**
  - Other
  - Software
- **Materials & Chemicals**
  - Nanomaterials
  - Other
- **Nanotechnology**
  - Materials
  - NanoBio
  - Tools and Devices

RELATED CASES

2015-023-0

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,863,136	01/09/2018	2015-023

RELATED MATERIALS

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