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Non-Confidential Description - PSU No. 2908
"Novel Process to Synthesize Colloidal Molecules"

Keywords:
Microspheres, Microbeads, Biospheres, Colloidal Particles

Links:
Inventor Website
Related Article

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Background

Colloidal and nanoparticles commonly serve as building blocks for more complex materials and devices. These range from traditional materials like coatings and ceramics, to modern devices like circuits, sensors, barcodes, photonics and colloidal crystals. In processing suspensions, two paramount challenges always exist for the particles: 1) controlling their aggregation stability, and 2) designing their self-assembly. Traditionally, stabilization is accomplished by passivating the particles (e.g. with dispersants), and assembly methods create relatively simple structures (e.g. films or uniformly-ordered crystals). Existing assembly technologies have a number of limitations, such as 1) closed-packed cluster shapes or simple particles, 2) particles of the same size and density, 3) limited production scale, and 4) particles assembled by one mechanism, which requires close-packed particles.

Invention Description

The subject invention describes a method to create "high information" particles (e.g., triplets with controlled particle orientations, particle clusters that appear as "toluene molecules") that can assemble bottom-up into more complex structures, with sizes from 10 nm to 10 microns. The technique opens the door to an almost arbitrary design of the particle shape and material resulting in unique bottom-up assembly configurations. Such "molecules" can be synthesized with arbitrary asymmetric properties, while starting with symmetric or asymmetric individual particles. The invention allows for the manipulation of three physical variables, including the particle size. The method allows for the use of electrostatics, hydrophobicity, receptor-ligand pairs, complementary DNA or other methods of "bonding" the particles together. For instance, the Penn State inventors have produced high quality, high selectivity colloidal doublets with no random doublets or aggregates. These heterodoublets are concentrated by centrifugation, thereby separating them from the "singlets." These "colloidal molecules" have the potential for a much higher information content than previous attempts in the literature. The inventors also believe that this process can be economically scaled up to the bulk quantities.

Advantages / Applications

Possible structures produced by this invention include a) computer circuits, b) complex catalysts, c) MEMS or NEMS machines, d) novel coating, e) research test particles, f) drug delivery, g) novel cosmetics, h) sensors and i) high-strength lightweight materials. The invention encompasses binding reactions such as antibody/antigen reactions, hapten reactions, nucleotide binding reactions, covalent binding reactions.

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