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GLOBULAR CRYSTALS: RESEARCH REVIEW TO REDEFINING GIANT MOLECULES FOR BIOPHOTONICS APPLICATION IN GREEN ELECTRONICS

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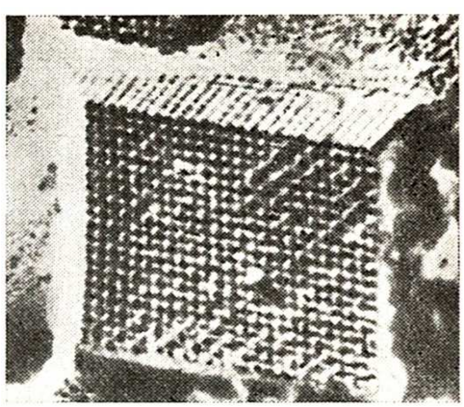
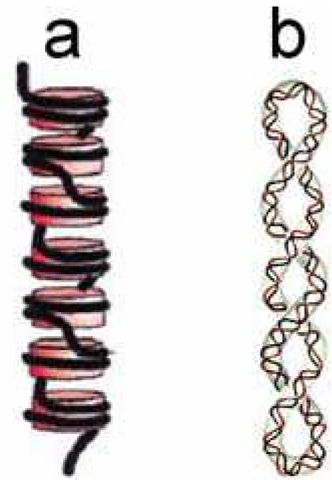
ABSTRACT

Chemist and technologist have been dealing for a long time with natural substances consisting long molecules in which the atoms are bound like a links of chain. We find example on every hand: abundant substances as rubber, cellulose, and proteins constitute chain type molecules made up many thousands of atoms. The structural conceptions of such molecules were formed and developed in the twenties, when chemist learned to produce such substances and polymers in their laboratories. Many molecules are capable of winding up into tight coils or, as they are sometimes called, **"globules"**. Very neat and quite identical globules make up a protein molecule. There is one subtle reason for this. As a matter of fact, a protein molecule contains parts that "like" water, and other parts that have an aversion to water. The parts that do not like water are said to be **hydrophobic**. The coiling of the protein molecules governed by a single tendency: all the hydrophobic parts are to be hidden inside the globules. This is why the globules in a solution of a protein resemble one another like identical twins. Protein globules are more or less spherical. The size of globules ranges from **100A to 300A**, making it readily visible under electron microscope. The first electron micrographs of globular crystals were obtained several decades ago, when electron microscopy techniques were considerably less advanced than they are today. Such a photograph of the tobacco mosaic virus shown in below exhibit.

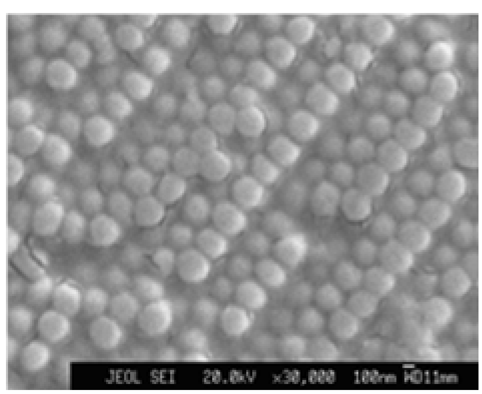


Keywords: Giant Molecules, Long-chain Organometalic Materials, Globular crystals, Biophotonics, Green Electronics, Opal globules.

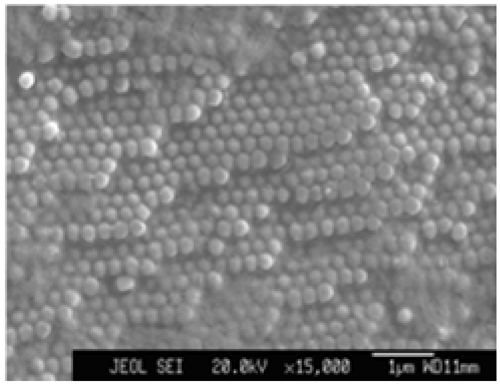
A virus is more complex than a protein but this example is quite suitable to illustrate our point, the tendency of biological globules to an exceptionally high degree of order. But why haven't authors provided a micrograph of protein a crystal? The answer is simple. Protein crystals are absolutely extraordinary. The content an immense amount of water (sometimes up to 90%). This makes it impossible to photograph them in an electron microscope. Protein crystals can be investigated only by manipulating then in solution. A tiny flask contains the solution and monocrystal of the protein. Notwithstanding the huge amount of water .i.e. ordinary water, no different from tap water-the globular protein molecules are arranged in absolutely strict order. Their orientation to the axis of crystal is the same for all the molecules. As already mentioned that the molecules are identical. This superior order enables the structure of the protein molecule to be determined. This is no simple task and the investigators **"Max Ferdinand Perutz (b. 1914) and John Cowdery Kendrew (b. 1917)"**, the first to determine the detailed structure of **hemoglobin and myoglobin**, were awarded a Nobel Prize for their work. The structure of about hundred molecules is known today. Research continue in this field and now up to the end of 2008, **G. Dovbeshko, O. Fesenko, V. Moiseyenko, V. Gorelik, V. Boyko and V. Sobolev** came with new research about "Globular crystals for Biophotonics Application", worked published in "**Semiconductor Physics, Quantum Electronics & Optoelectronics, 2008. V. 11, N 4. P. 392-395'. And "V.S. Gorelik, Optics of globular photonic crystals Kvantovaya elektronika 37(5), p. 409-502 (2007) (in Russian)".** Some investigated globular crystals are The DNA chain wraps around small, positively charged globular proteins called histones, as in eukaryotic nucleosomes, forming a left-handed solenoidal structure as shown in exhibit below.



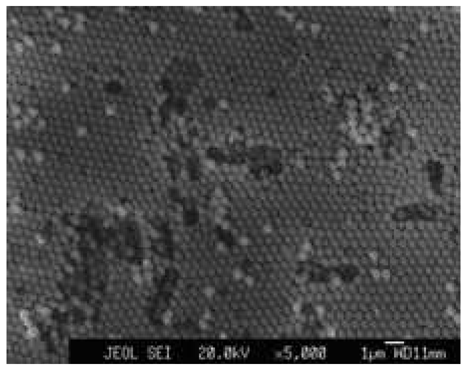
Biological self-assembly provides illustrations of thermodynamically stable supramolecular arrays that not only have regular architectures but also have intelligent functions. Inspired by the convenience of organizing molecules via noncovalent associations, self-assembly has undoubtedly been an active field of current chemistry and has found wide application. Among all of the building blocks suitable for self-assembly, many researchers concentrate on the synthetic molecules and have obtained many results; on the other hand, many researchers use DNA, proteins, lipids, and even viruses to fabricate potential biological materials. For example, Cao and Armitage et al. synthesized and characterized thermo reversible biopolymer microgels based on hydrogen bonding of DNA and recoverable enzymatic microgel based on biomolecular recognition. Since the late 1980s, natural scientists have introduced a multiplicity of new terms and definitions. We had to learn the difference between genes and proteins, we have been taken into the miniature world of viruses and prions, and the newspapers report on a great many new technologies, such as biotechnology, information technology and nanotechnology, and nowadays even on bionanotechnology. The development of those new technologies combines an increase of both the scientific and also the technological understanding and knowledge of, for example, life processes and has already led to economic profit as well as to enormous stock-exchange quotations. However, apart from undreamed-of possibilities for mankind, the new technologies also entail ethical risks and problems as we can conclude from the discussion on the first cloned sheep “Dolly” or the application of embryonic stem cells. Rather than entering into a detailed discussion, we will stop here, and instead introduce a fairly new discipline of natural science: Biophotonics. Biophotonics deals with the interaction between light and biological systems. The word itself is a combination of the Greek syllables *bios* standing for life and *phos* standing for light. Photonics is the technical term for all procedures, technologies, devices, etc. utilizing light in interaction with any matter. Before we discuss Biophotonics in more detail, we focus first and foremost on the achievements of Photonic Technologies, which are often used synonymously with Photonics. The advanced control and manipulation of light now available make Photonics as powerful as Electronics. One major goal is to incorporate even more photonically driven processes into our daily lives. Therefore, Photonics is considered as a key technology of the twenty-first century. Photonics encompasses the entire physical, chemical and biological laws of nature, together with technologies for the generation, amplification, control, manipulation, propagation, measurement, harnessing and any other type of utilization of light. This rather broad definition of Photonics emphasizes the huge importance of light for our modern human society. Photonics is a key technology for solving momentous problems in the domains of health care, food production and technology, environmental protection, transportation, mobility, etc. It is a peacemaking technology for other developments such as communication and production technology, biotechnology and nanotechnology. Just one brief example of what the near future holds: conventional lighting by light bulbs, neon lamps or fluorescent tubes will be a thing of the past. Photonic crystals as a new class of materials take place between nano- and micro structural highly ordered composites. Electromagnetic wave propagation through a structure with sizes of elements close to the wavelength leads to Bragg diffraction, multiple scattering, *etc*. As a result of this process, a forbidden photonic band arises. Photonic crystals with a tunable forbidden band are of interest for researchers and technical applications. By M. Barabanenkov and V. Kosobukin opal having the fine globular structure with 0.2-0.5 μm size, above the globular structure (2-5 μm and superfine structure consisting of small balls with 0.05 μm sizes could be useable for biophotonics applications.



A – *Ordered globules*



B – Globules organized in terraces of mosaic structure –"strip" type



C – *Disordering in a microstructure of opal (best condition for Biophotonics application having photonics band gap)*

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