

Definition

Selenocysteine is a rare biological ► **amino acid** found in several enzymes. Its structure is similar to cysteine's, but it has a selenium atom replacing the usual sulfur atom, thus forming a selenol group. Selenocysteine is a stronger acid and has a higher reduction potential than ► **cysteine**. These properties make it optimal for incorporation in proteins involved in antioxidant activity.

Selenocysteine is not directly coded for in the genetic code; rather, it is encoded by a UGA ► **codon**, which is normally a stop codon. The UGA codon is made to encode selenocysteine by the presence of a SECIS (SElenoCysteine Insertion Sequence) element in the coding mRNA. The SECIS element is defined by characteristic nucleotide sequences and secondary structure base-pairing patterns. In bacteria, the SECIS element is located immediately following the UGA codon in the reading frame for the selenoprotein. In archaea and eukaryotes, the SECIS element is in the 3' untranslated region of the mRNA, and can direct multiple UGA codons to encode selenocysteine residues. Unlike the other coded amino acids, no free pool of selenocysteine exists in the cell. Its high reactivity would incur damage to cells. Instead, cells store selenium in the form of the less reactive selenide (H₂Se). Selenocysteine is biosynthesized in situ on a specialized tRNA. In these days, selenocysteine is sometimes included in additional protein amino acids together with pyrrolysine.

See also

- **Amino Acid**
- **Codon**
- **Cysteine**
- **Non-Protein Amino Acids**
- **Secondary Structure (Protein)**

Selenology

Synonyms

Lunar geology

Definition

Selenology (Greek, *Selene* "Moon," *logos* "speech, science") is the science of the ► **Moon**. It comprises the study of the structure, composition, physical properties, dynamics, origin, and evolution of the Moon, as well as the processes that formed and shaped the Moon. The term selenology is not frequently used because

scientifically and methodologically it is synonymous to "Lunar Geology." Thus the latter is commonly used instead of the term "Selenology."

See also

- **Areology**
- **Chronology, Cratering and Stratigraphy**
- **Geological Time Scale, History of**
- **Moon, The**
- **Satellite or Moon**
- **Stratigraphy**

Self Assembly

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Synonyms

Self-organization

Keywords

Computation, formation, pattern, structure

Definition

Self-assembly is the process by which preexisting components (separate or distinct parts of a disordered structure) autonomously organize into patterns or structures without external intervention.

Overview

Self-assembly processes are responsible for the generation of much of the order in nature (Philp and Stoddart 1996; Whitesides and Grzybowski 2002). They involve components at different scales, such as molecules, cells, and organisms. The characteristics of the components control how they interact with each other and thus the patterns and structures that emerge. The components must be mobile, being either externally propelled or self-propelled. In many self-assembly systems, the components selectively bind to, or selectively disband from, each other. Such selective binding regulates, for instance, the replication of genetic information in the assembly of the DNA double helix. Self-assembly processes are either static or dynamic. In static self-assembly, the systems of components do not dissipate energy and reach an ordered state at global or local equilibrium. An example of static

self-assembly is molecular crystallization. In dynamic self-assembly, the systems of components dissipate energy in order to form and maintain patterns or structures far from equilibrium. An example of dynamic self-assembly is cell sorting in embryos. In general, dynamic self-assembly systems tend to be more complex than static self-assembly systems. Typically, the components' behaviors (e.g., their binding preferences) are not static but change in response to interactions with other components or the environment. For biological systems, the characteristics of their components undergo evolution as the patterns and structures resulting from the interactions amongst components are selected for specific functions (Caspar 1996; Sendova-Franks and Franks 1999; Anderson et al. 2002).

At present, researchers are working toward a more unifying theory of self-assembly and a profound understanding of its elementary functions and limits. One such attempt is to view the products of self-assembly systems as computations, and vice versa. For example, it was found that systems based on DNA tiles that implement such algorithmic self-assembly can perform Turing-universal computation.

Until now, self-assembly has most widely been applied in the synthesis and fabrication of products from molecular components. However, increasingly, the potential of self-assembly processes with mesoscopic to macroscopic components is recognized (Whitesides and Boncheva 2002; Groß and Dorigo 2008). At these scales, the characteristics of the components can be precisely controlled and the self-assembly processes can be easily monitored. Potential applications include crystal synthesis with nanometer- to centimeter-scale components, fabrication of electrically or optically functional devices, and autonomous robots with adaptive body plans and functionalities.

See also

- ▶ Emergence of Life
- ▶ Molecular Recognition
- ▶ Self Assembly (Biological)
- ▶ Self Replication

References and Further Reading

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Self Assembly (Biological)

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Synonyms

Self organization

Keywords

Hydrogen bonds, hydrophobic effect, lipid bilayer, secondary and tertiary protein structures

Definition

Self-assembly is the process by which certain kinds of molecules in solution are able to associate into larger, more complex structures stabilized by hydrogen bonding and other generally non-covalent interactions.

Overview

The four forces that stabilize the structures of biomolecules are covalent bonds, hydrogen bonds, electrostatic interactions, and the hydrophobic effect. The synthesis of covalent bonds requires a significant expenditure of energy, and is not usually associated with self-assembly processes, which are low energy reactions that occur spontaneously without a direct input of metabolic energy. An example of self-assembly is the formation of secondary and tertiary structure of proteins, in which hydrogen bonding is essential. For instance, when peptide chains are synthesized by ribosomes, portions of the growing strand form hydrogen-bonded alpha helices and planar structures called beta sheets. These structures arise spontaneously and are dominant features of most proteins. Another fundamental biological structure stabilized by hydrogen bonds is the ▶ **double helix** of DNA, in which adenine is paired with thymine with two ▶ **hydrogen bonds**, and guanine paired with cytosine with three hydrogen bonds. These are now referred to as Watson-Crick base pairs, and more generally as complementary base pairing. If a DNA double helix is separated into single strands, for instance by heating, upon cooling the two strands reassemble into the original double-helix structure.