

Essays park

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Self-assembly in the classic sense refers to the autonomous and spontaneous organization of molecules and/or artificial components into patterned and well-organized structures without human or machine intervention. In other words, self-assembly spontaneously and autonomously creates patterned or structured substances with a remarkable order out of largely disordered components. From physical point-of-view, self-assembly process can be classified in two main kinds of “static self-assembly” and “dynamic self-assembly”.

Static self-assembly refers to processes involving systems that are already at or are approaching global or at least local equilibrium without energy dissipation and there is no pre-existing patterns prior to self-assembly occurs. In this form of self-assembly, the fabrication of ordered structures may need some sort of external energy e. g. stirring; though, once the process is accomplished, the self-assembled structure is stable and cannot be adjusted or reconfigured, unless a different equilibrium state is reached as a result of changing environment. Formation of molecular crystals and protein crystals, stable surfactant-free self-assembly of micelle-like nanostructures, supramolecular self-assembly of single- and multi-walled tubes, DNA-guided self-assembly of single- and multi-component nanostructures, synthesis of self-assembled nanostructured proteins for therapeutic purposes, and self-assembly of block copolymers into giant polymer vesicles, are exemplary of static self-assembly. In contrast, in dynamic self-assembly the process occurs outside of the thermodynamic equilibrium (i. e.

out-of-equilibrium) and the formation of patterns and structures only occurs if the system is dissipating energy, e. g. in form of heat.

In this category, ordered structures are formed out of pre-existing non-ordered patterns and structures through input of energy delivered either chemically or by an external energy source, and this energy dissipates. For instance, formation of patterns in reaction-diffusion systems, self-assembly of millimeter-sized magnetic discs, controlled self-assembly in microfluidic systems, fabrication of two and three-dimensional arrays of magnetic colloidal crystals, self-assembly of crystalline microstructures through capillary forces, formation of electronic devices and circuits, DNA templating, and any living organism are examples of dynamic self-assembly.