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Chemical Systems for Life Science

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Abstract. The use of dynamic, adaptive materials with feedback control is a tendency of the past decade. Life sciences and medicine require materials with the controlled and responsive assembly of various components on the scales from molecular to macroscopic and even robotics. The main idea of this review is the use of synthetic systems as regulatory networks that facilitate the integration of chemical and biological materials. The synthetic systems, which are inspired by biochemical regulatory networks, help synthetic material to adapt to environmentand to interact with living matter cooperatively. The first step in realizing this concept is designing simple model systems. The simplicity means that the system should contain a minimal number of components but should be robust and sustainable to perform the required functions through logic operations and feedback loops. Here we suggest specific examples of robust systems for the selected functionality: compartmentalized signaling cascades, computation with light-induced chemical gradients andadvanced biomimetic mixed organic-inorganic materials, and self-regulation in chemical-biological systems. The main challenges for the given examples are discussed, and future prospects of logic operation with chemical systems are provided.

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