

Book review

Biomimetics: a molecular perspective

Raz Jelinek

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Biomimetics represents a young scientific discipline and is best described by the author as ‘harnessing biology for creating useful devices and materials’. An interesting example of an inspiring biological phenomenon is represented on the book cover: the lamellae structures on the gecko’s feet that allow it to cling to all types of surfaces. Millions of years of evolution have resulted in this superb feature and technology may advance tremendously by mimicking concepts such as this. As outlined in Chapter 1, this book has its focus on biomimetic molecular systems with a close link to nanotechnology.

The book follows a bottom-up approach, as do many of the applications described, starting off by defining bio-inspired and bio-hybrid materials in Chapter 2. As artificial entities these may not only mimic biological structures, but also perform biological tasks and functions. In addition to a bottom-up engineering approach by the assembly of simple elements into hierarchical structures, entire organisms, such as viruses and bacteria, can be employed for the production of materials and device components.

The following chapters focus on fascinating natural structures and phenomena and the achievements made in mimicking these. Chapter 3 demonstrates the development in biomimetic surfaces. Approaches herein are two-fold: bio-inspired materials and synthetic interfaces, in which the biological components confer useful properties, and also biological interfaces, in which artificial synthetic elements are designed to alter or enhance the biological properties. Chapter 4 describes the attempts to create artificial organs and tissues via tissue engineering, defined as the structural and functional reconstitution of tissues, in which cells, biomaterials, and biological signals are combined to fully mimic their physiological settings. Among the more innovative recent approaches is the development of tissue-on-chip systems, representing powerful tools for drug discovery and testing. Chapter 5 covers biomineralization, the concept in which organisms use biomolecules and biological substances to assemble inorganic structures. Synthetic templates for biomineralization have been developed that can generate

biologically-induced inorganic patterns when combined with surface lithography technology.

A new science at the interface of biology, chemistry, and materials science is introduced in Chapter 6 as synthetic biology, interpreted as the construction of biological systems, in which cells and even whole organisms are built from completely artificial components. This chapter, as well as Chapter 7 with its focus on artificial cells, reveals science-fiction being close to reality. Even the basic elements of nature, such as the oligonucleotides that reconstitute DNA, amino acids that reconstitute proteins, and other functional biomolecules can be synthetically mimicked and may form the basis for ‘artificial life’. The developments toward artificial cells create an intense awareness of the intriguing and fascinating complexity of nature. Even though the basic elements of cells can be mimicked, the requisites such as self-maintenance, reproduction, and the ability to evolve over time, are still highly challenging from a synthetic point-of-view.

The Chapters 8 and 9, describing advances in drug delivery technologies and DNA and RNA nanotechnology are considered redundant as many of the concepts discussed here have been touched on in the other chapters and consequently these chapters contain overlapping sections with the previous chapters. Chapter 10 summarizes the development of several artificial systems that mimic broader contours of fundamental biological phenomena. Among these are the development of catalytic antibodies, artificial photosynthesis, bio-inspired motors, artificial muscles, electronic noses, and biologically-inspired computers.

The book is well-written, easy-to-read, and interesting to researchers of many disciplines, such as chemists, physicists, material scientists, bioengineers, and biologists. It contains numerous examples of interesting natural features that have inspired technology developments by prominent recognized research groups. Overall, this book is a delight to anyone with an interest in biological phenomena translated into technological concepts.

Anita Driessen-Mol

Department of Biomedical Engineering

Eindhoven University of Technology

Den Dolech 2

5612 AZ Eindhoven

The Netherlands

E-mail: a.driessen@tue.nl