NANOBIOTECHNOLOGY
Research and applied science, as we see it today, has advanced to a place in which, instead of manipulating substances at the molecular level, we can control them at the atomic level. This exciting operational space, where the laws of physics shift from Newtonian to quantum, provides us with novel discoveries, which hold the promise of future developments that, until recently, belonged to the realm of science fiction.

Nanobiotechnology is a multidisciplinary field that covers a vast and diverse array of technologies from engineering, physics, chemistry, and biology. It is expected to have a dramatic infrastructural impact on both nanotechnology and biotechnology. Its applications could potentially be quite diverse, from building faster computers to finding cancerous tumors that are still invisible to the human eye. As nanotechnology moves forward, the development of a ‘nano-toolbox’ appears to be an inevitable outcome. This toolbox will provide new technologies and instruments that will enable molecular manipulation and fabrication via both ‘top-down’ and ‘bottom-up’ approaches.


Section 1 is an introductory overview on nanobiotechnology, which briefly describes the many aspects of this field, while addressing the reader to relevant sources for broader information overviews.

Biological materials can serve as nanotemplates for ‘bottom-up’ fabrication. In fact, this is considered one of the most promising ‘bottom-up’ approaches, mainly due to the nearly infinite types of templates available. This approach is demonstrated in Section 2.

The convergence of nanotechnology and biotechnology may combine biological and man-made devices for the design and fabrication of bionanoelectronics and for their use in nanocomputing. This area is addressed in Section 3, which covers the use of biological macromolecules for electron transfer and computation.

One of the main reasons nanobiotechnology holds so much promise is that it operates at the biological size scale. Biological molecules (such as enzymes, receptors, DNA), microorganisms and individual cells in our
bodies are all nano-sized. Engineered ultrasmall particles that are made in
the exact size needed to perform specific tasks, such as drug release in par-
ticular locations in the body, drug delivery into the blood stream, or to pin-
point malfunctioning tissues (cancerous tissue, for example), are examples
of the new medical discipline termed ‘nanomedicine’. Section 4 gives a brief
look at this extensive and rapidly growing field.

The fact that nanobiotechnology embraces and attracts many different dis-
ciplines, encompassing both researchers and business leaders, has produced
many examples of bio-inspired de novo designed structures. Each scientific
group approaches the molecular level with unique skills, training, and lan-
guage, and a few examples are presented in Section 5. Cross-talk and collabor-
ative research among academic disciplines, and between the researchers and
their counterparts in business, are critical to the advancement of nanobiotech-
nology and constitute the foundation for the new material generation.

Working at the molecular or atomic level allows researchers to develop
innovations that will dramatically improve our lives. The new territory of
bionanotechnology holds the promise of improving our health, our industry,
and our society in ways that may even surpass what computers and biotech-
nology have already achieved.

_Ilan Levy and Oded Shoseyov_
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CONTRIBUTORS

KENJI ARINAGA, Walter Schottky Institut, Technische Universitaet Muenchen, Garching, Germany, and Fujitsu Laboratories Ltd., Atsugi, Japan
LANE A. BAKER, Departments of Chemistry and Anesthesiology, University of Florida, Gainesville, FL
ROBERT R. BIRGE, Department of Molecular and Cell Biology, and Department of Chemistry University of Connecticut, Storrs, CT
STEFAN H. BOSSMANN, Kansas State University, Department of Chemistry, Manhattan, Kansas
JIN-HO CHOI, Center for Intelligent NanoBio Materials (CINBM), Department of Chemistry and Division of Nanoscience, Ewha Womans University, Seoul 120-750, Korea
GIANAURELIO CUNIBERTI, Molecular Computing Group, Institute of Theoretical Physics, University of Regensburg, Regensburg, Germany
ROSA DI FELICE, National Center on nanoStructures and bioSystems at Surfaces (S3) of INFM-CNR, Modena, Italy
EVA-M. EGELSEER, Center for NanoBiotechnology, University of Natural Resources and Applied Life Sciences, Vienna, Austria
JOSEPH FARFEL, Department of Computer Science, Duke University, Durham, NC
ERAN GABBAI, Do-Coop Technologies Ltd, Or Yehuda, Israel
EHUD GAZIT, Department of Molecular Microbiology and Biotechnology, Tel Aviv University, Tel Aviv, Israel
RAFAEL GUTIERREZ, Molecular Computing Group, Institute of Theoretical Physics, University of Regensburg, Regensburg, Germany
TETSUYA HARUYAMA, Department of Biological Functions and Engineering, Kyushu Institute of Technology, Fukuoka, Japan
JASON R. HILLEBRECHT, Department of Molecular and Cell Biology, University of Connecticut, Storrs, CT
KEWAL K. JAIN, PharmaBiotech, Basel, Switzerland
TAPAN K. JAIN, Department of Pharmaceutical Sciences, College of Pharmacy, University of Nebraska Medical Center, Omaha, NE
KATHARINE JANIK, Kansas State University, Department of Chemistry, Manhattan, Kansas
NATAŠA JONOSKA, University of South Florida, Department of Mathematics, Tampa, FL
Contributors

ANDREAS KAGE, Charité Universitätsmedizin Berlin, Zentralinstitut für Laboratoriumsmedizin und Pathobiochemie, Berlin, Germany
JEREMY F. KOSCIELECKI, Department of Chemistry, University of Connecticut, Storrs, CT
MARK P. KREBS, Department of Ophthalmology, College of Medicine, University of Florida, Gainesville, FL
VINOD LABHASETWAR, Department of Biomedical Engineering, Lemer Research Institute, Cleveland Clinic, Cleveland, OH
KATARZYNA LAMPARSKA-KUPSIK, City of Hope National Medical Center and Beckman Research Institute, Duarte, CA
ILAN LEVY, Intel Research Israel, Intel Electronics, Jerusalem, Israel
LOREN LIMBERIS, Department of Engineering, East Carolina University, Greenville, NC
CHARLES R. MARTIN, Departments of Chemistry and Anesthesiology, University of Florida, Gainesville, FL
MICHAEL NIEDERWEIS, University of Alabama at Birmingham, Department of Microbiology, Bevill Biomedical Research Building, Birmingham, AL
JAE-MIN OH, Center for Intelligent NanoBio Materials (CINBM), Department of Chemistry and Division of Nanoscience, Ewha Womans University, Seoul 120-750, Korea
MAN PARK, Center for Intelligent NanoBio Materials (CINBM), Department of Chemistry and Division of Nanoscience, Ewha Womans University, Seoul 120-750, Korea
MEGH RAJ POKHREL, Central Department of Chemistry, Tribhuvan University, Kirtipur, Kathmandu, Nepal
DANNY PORATH, Physical Chemistry Department and Center for Nanoscience and Nanotechnology, The Hebrew University of Jerusalem, Israel
DIETMAR PUM, Center for NanoBiotechnology, University of Natural Resources and Applied Life Sciences, Vienna, Austria
ULRICH RANT, Walter Schottky Institut, Technische Universitaet Muenchen, Garching, Germany
MARAM K. REDDY, Department of Biomedical Engineering, Lemer Research Institute, Cleveland Clinic, Cleveland, OH
JENNIFER SAGER, Department of Computer Science, University of New Mexico, Albuquerque, NM
SANJEEB K. SAHOO, Institute of Life Sciences, Nalco Square, Bhubaneswar, Orissa, India
Contributors

Margit Sára, Center for NanoBiotechnology, University of Natural Resources and Applied Life Sciences, Vienna, Austria
Bernhard Schuster, Center for NanoBiotechnology, University of Natural Resources and Applied Life Sciences, Vienna, Austria
Oded Shoseyov, The Institute of Plant Science and Genetics in Agriculture and The Otto Warburg Center for Agricultural Biotechnology, Faculty of Agricultural, Food and Environmental Quality Sciences, The Hebrew University of Jerusalem, Rehovot, Israel
Uwe B. Sleytr, Center for NanoBiotechnology, University of Natural Resources and Applied Life Sciences, Vienna, Austria
Steven S. Smith, City of Hope National Medical Center and Beckman Research Institute, Duarte, CA
Darko Stefanovic, Department of Computer Science, University of New Mexico, Albuquerque, NM
Russell J. Stewart, Department of Bioengineering, University of Utah, Salt Lake City, UT
Jeffrey A. Stuart, W. M. Keck Center for Molecular Electronics, Syracuse University, Syracuse, NY
Marc Tornow, Institute of Semiconductor Technology, Technical University of Braunschweig, Braunschweig, Germany
Hans-Achim Wagenknecht, University of Regensburg, Institute of Organic Chemistry, Regensburg, Germany
Kevin J. Wise, Department of Molecular and Cell Biology, University of Connecticut, Storrs, CT