Metal Nanoparticles in Microbiology

Mahendra Rai • Nelson Duran
Editors

Metal Nanoparticles in Microbiology

Springer

Editors
Mahendra Rai, Ph.D.
Professor and Head
Biotechnology Department
SGB Amravati University
Amravati-444 602
Maharashtra, India
mkrai123@rediffmail.com

Professor Nelson Duran
Biological Chemistry Laboratory
Instituto de Química
Universidade Estadual de Campinas
CEP 13084862, Caixa Postal 6154
Campinas, S.P., Brazil
duran@iqm.unicamp.br

ISBN 978-3-642-18311-9 e-ISBN 978-3-642-18312-6
DOI 10.1007/978-3-642-18312-6
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2011925677

Cover design: deblik, Berlin

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

Nanotechnology is a multidisciplinary and interdisciplinary science dealing with various aspects of research and technology at nanolevel. Nanoparticles range from 1 to 100 nm, which form building blocks of nanotechnology. Metal nanoparticles such as gold, silver, platinum and copper have gained considerable attention in recent times due to their fundamental and technological interest. These nanoparticles have unique catalytic, electronic and optical properties different from the metallic particles. Usually, the nanoparticles can be synthesized by physical, chemical and biological methods. The physical and chemical methods involve the use of strong chemical reducing agents such as sodium borohydride and weak reducing agents such as sodium citrate, alcohols, use of gamma- and UV rays, etc. Studies have reported that the biological methods depict an inexpensive and eco-friendly method for synthesis of nanoparticles. To date, biosynthesis of nanoparticles has been demonstrated by the use of biological agents such as bacteria, fungi, yeasts actinomycetes and plants.

Synthesis of nanoparticles using microbes or plants is a new and emerging eco-friendly science. Many investigators have been using biological methods for the synthesis of nanoparticles. So far, there is no book on biogenic nanoparticles. Therefore, this would be the first book of its kind all over the world.

The book covers synthesis of nanoparticles by different microbes (bacteria, cyanobacteria and fungi) and plants, the mechanism involved in biosynthesis and multiple applications of the nanoparticles.

The book would be immensely useful for diverse discipline of students and teachers of nanotechnology, biology, chemistry, physics, botany, zoology, chemical technology, earth sciences, medicine, pharmacology, mycology, microbiology, pathology and biotechnology.

The book incorporates the contributions of leading researchers in the field of biogenic metal nanoparticles. The editors highly appreciate the contribution by eminent scholars and their patience during the publication of the book.

We wish to express our sincere thanks to Dr. Jutta Lindenborn for her continued interest, critical suggestions and prompt response during the editing process. MKR

and ND thankfully acknowledge the help and support rendered by the students. MKR expresses thanks to his children Shivangi, Shivani and Aditya for their unconditional love, support and help.

Amravati, Maharashtra, India — Mahendra Rai
Campinas, SP, Brazil — Nelson Duran

Contents

Contributors

Ahmad-Reza Shahverdi, Department of Pharmaceutical Biotechnology and Biotechnology Research Center, Tehran University of Medical Sciences, Tehran, Iran, shahverd@sina.tums.ac.ir

Alka Yadav, Department of Biotechnology, Sant Gadge Baba Amravati University, Amravati 444 602, Maharashtra, India

Aniket Gade, Department of Biotechnology, Sant Gadge Baba Amravati University, Amravati 444 602, Maharashtra, India

Charoen Sanpawanitchakit, EnviroGroup Limited, 3561 Stagecoach Road, Suite 205, Longmont, CO 80504, USA

Chris Whiteley, Department of Biochemistry, Microbiology and Biotechnology, Rhodes University, P.O.Box 94, Grahamstown 6140, South Africa, C.Whiteley@ru.ac.za

Christopher T. Lefèvre, School of Life Sciences, University of Nevada at Las Vegas, 4505 Maryland Parkway, Las Vegas, NV 89154-4004, USA, christopher.lefevre@unlv.edu

Clemens Posten, Department of Bioprocess Engineering, Institute of Process Engineering in Life Sciences, Karlsruhe Institute of Technology, Fritz-Haber-Weg 2, build. 30.44, Karlsruhe, Germany, clemens.posten@kit.edu

Debabrata Dash, Department of Biochemistry, Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India, ddass@sify.comddass@stayam.net.in

Dennis A. Bazylinski, School of Life Sciences, University of Nevada at Las Vegas, 4505 Maryland Parkway, Las Vegas, NV 89154-4004, USA, dennis.bazylinski@unlv.edu

Fernanda Abreu, Instituto de Microbiologia Professor Paulo de Góes, Universidade Federal do Rio de Janeiro, 21941-590 Rio de Janeiro, Brazil, abreufernandadeavila@hotmail.com

Gurunathan Sangiliyandi, Department of Biotechnology, Kalasalingam University, Anand Nagar, Krishnankoil 626190, Tamil Nadu, India, lvsangs@yahoo.com

Irena H. Maliszewska, Chemical Faculty Wybrzeze, Wrocław University of Technology, Wyspianskiego 27, 50370 Wroclaw, Poland; Division of Medicinal Chemistry and Microbiology, Faculty of Chemistry, Wrocław University of Technology, Wyspiańskiego 27, 50-370 Wrocław, Poland, irena.helena.maliszewska@pwr.wroc.pl

Iliasov P., G. K. Skryabin Institute of Biochemistry and Physiology of Microorganisms, RAS, 142290, Pushchino, Nauki Av., 5, Russia

Kalimuthu Kalishwaralal, Department of Biotechnology, Kalasalingam University, Anand Nagar, Krishnankoil 626190, Tamil Nadu, India

Maggy F. Lengke, Geomega Inc., 2525 28th Street, Suite 200, Boulder, CO 80301, USA, maggylengke@yahoo.com

Mahendra Rai, Department of Biotechnology, Sant Gadge Baba Amravati University, Amravati-444 602, Maharashtra, India, mkrai123@rediffmail.com, pmkrai@hotmail.com

Mojtaba Shakibaie, Department of Pharmaceutical Biotechnology and Biotechnology Research Center, Tehran University of Medical Sciences, Tehran, Iran; Department of Pharmaceutical Biotechnology, Kerman University of Medical Sciences, P.O. Box 76175-493, Kerman, Iran, m_shakibaei@razi.tums.ac.ir

N. Vigneshwaran, Chemical and Biochemical Processing Division, Central Institute for Research on Cotton Technology, Adenwala Road, Matunga, Mumbai, Maharashtra 400019, India, nvw75@yahoo.com

Nelson Durán, Chemistry Institute, Biological Chemistry Laboratory, Universidade Estadual de Campinas, C.P. 6154, CEP 13083-970 Campinas, São Paulo, Brazil; Natural Science and Humanity Center, Universidade Federal de ABC, Santo Andre CEP 09.210-170, Sâo Paulo, Brazil, duran@iqm.unicamp.br

Nikolay Krumov, Department of Bioprocess Engineering, Institute of Process Engineering in Life Sciences, Karlsruhe Institute of Technology, Fritz-Haber-Weg 2, build. 30.44, Karlsruhe, Germany, nikolay.krumov@kit.edu

Pardis Nazari, Department of Pharmaceutical Biotechnology and Biotechnology Research Center, Tehran University of Medical Sciences, Tehran, Iran, pnazari@razi.tums.ac.ir

Prateek Jain, Chemical and Biochemical Processing Division, Central Institute for Research on Cotton Technology, Adenwala Road, Matunga, Mumbai, Maharashtra, 400019, India

Priscyla D. Marcato, Chemistry Institute, Biological Chemistry Laboratory, Universidade Estadual de Campinas, C.P. 6154, CEP 13083-970 Campinas, São Paulo, Brazil, pmarcato@gmail.com

Reshetilov A., G. K. Skryabin Institute of Biochemistry and Physiology of Microorganisms, RAS, 142290, Pushchino, Nauki Av., 5, Russia, anatol@ibpm.pushchino.ru

Reshetilova T., G. K. Skryabin Institute of Biochemistry and Physiology of Microorganisms, RAS, 142290, Pushchino, Nauki Av., 5, Russia

Siddhartha Shrivastava, Department of Biochemistry, Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

Sunil K. Singh, Department of Biochemistry, Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

Sureshbabu Ram Kumar Pandian, Department of Biotechnology, Kalasalingam University, Anand Nagar, Krishnankoil 626190, Tamil Nadu, India

Tamsyn Riddin, Department of Biochemistry, Microbiology and Biotechnology, Rhodes University, P.O.Box 94, Grahamstown 6140, South Africa

Ulysses Lins, Instituto de Microbiologia Professor Paulo de Góes, Universidade Federal do Rio de Janeiro, 21941-590 Rio de Janeiro, Brazil, ulins@micro.ufrj.br

Venkataraman Deepak, Department of Biotechnology, Kalasalingam University, Anand Nagar, Krishnankoil 626190, Tamil Nadu, India

Yageshni Govender, Department of Biochemistry, Microbiology and Biotechnology, Rhodes University, P.O.Box 94, Grahamstown 6140, South Africa

Zygmunt Sadowski, Chemical Faculty Wybrzeze, Wrocław University of Technology, Wyspianskiego 27, 50370 Wroclaw, Poland, zygmunt.sadowski@pwr.wroc.pl