



Nano: The Essentials – Understanding Nanoscience and Nanotechnology. T. Pradeep. Tata McGraw-Hill, New Delhi. 2007. 432 pp. Price not mentioned.

For any new technology, public perception plays a critical role in its eventual deployment and commercial acceptance. Nanotechnology is not an exception, despite being considered by many as the newly emerging, ultimate technology with abundant promises to solve all sorts of problems faced by humanity. On the other hand, opponents accuse this as being too 'far-fetched' and fictitious with undue publicity and this has been widely criticized as a mere waste of public money with inherent dangers of the unjustified hype by the invisible nanoworld. Irrespective of these opposing views, there has been plenty of excitement with new fundamental phenomena and in this respect, the book by Pradeep brilliantly exposes some of the overriding concerns of both the scientific community and the public at large, although written primarily for undergraduate students.

This book has four parts dealing with various aspects of nanoscience and nanotechnology, while a fifth part highlights societal implications. Public opinion on nanotechnology is at its infancy and the potential benefits are generally considered to outweigh the risks. More debate is desired in many of these areas, and some of the important concerns raised in this book have far-reaching consequences to address wider sociological issues related to 'exaggerated benefits for fund accumulation', 'hyped applications for political advantages', 'unethical practice of science and technology for personal benefits', etc. This book, I believe, will elicit such responses, at least from a large group of students and teachers, interested in nanotechnology.

The author provides an elegant introduction in the first part with beautiful photographs of the celebrated gold nanoparticles prepared by Faraday and also

the Lycurgus cup made in the 4th century AD. Many important points about the uniqueness of nanotechnology are, however, missing in the introduction and statements like 'Everything one purchases today has an integrated circuit in it' (p. 8) are gross simplifications. This chapter is followed by a concise (though not essentially exclusive) description of popular techniques used for nanolevel manipulation and characterization, which will be useful for students. The third part displays the up-to-date diversity in nanosystems along with their relevance to specific applications. These three parts are organized in such a way that even a novice could relish the concepts of nanotechnology. Next comes the fourth part, which could really serve as a handbook of interdisciplinary applications of nanotechnology. In particular, the chapters on nanobiology (chapter 11) and nanomedicine (chapter 13) are written well with minimum jargon, to expose a general reader understand the latest developments. However, in p. 264 (chapter 11), the five categories could have, in principle be merged into three, although in the text, it is written as 'four major aspects'. In addition, this chapter has many errors, suggesting that it was written in a hurry.

One of the major highlights of the book is that it provides a detailed history of nanoscience and nanotechnology along with a glossary in the appendix. This is a unique feature, hardly found in any other textbooks in this field, which is indeed essential to popularize an interdisciplinary field like nanotechnology among the public. Nevertheless, several errors, typographic and otherwise, are present and the author should correct them in the second edition. Many portions of this book, especially part three, could be effectively used by researchers and students working on the preparation and characterization of a variety of metallic and semiconducting nanoparticles, fullerenes, carbon nanotubes, gas-phase clusters and core-shell particles. But, for others working in metallurgy and ceramic oxides, this will be of only marginal interest. Further, the selection of chapter topics indicates a strong bias, as crucial information on the importance of nano electromechanical systems (NEMS) and smart or intelligent materials designed by the effective use of nanostructured functional materials is missing.

In summary, this book provides useful information on most of the essential aspects of nanoscience and nanotechnology.

Hence I recommend it as an excellent resource book for both students and teachers interested in nanotechnology. Since nanotechnology, at least in principle, could solve many problems of today, this book has succeeded in bringing out the relevance of the field to the scientific community.

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'I have met people who believed they knew at a very early age what they wanted to do in their lives. I envied them, but my own life was not like that' is a statement made by H. Gobind Khorana (*Science*, 2000, **287**, 810). In the lead article of the 2006 edition of the *Annual Review of Microbiology*, in his memoirs, the author Dale Kaiser states, 'My career in microbiology has been a journey – a journey whose destination was never clear along the way'. Such bold statements are inspirational and a reminder that one could do science for the fun of it, and one could let the experiments take the enquiring mind onto a road whose destination was not already decided. Dale Kaiser made classic contributions to the biology of bacteriophage λ . His subsequent studies on the morphogenesis of myxobacteria have been equally rewarding in identifying the mechanisms of multicellular development in *Mixococcus xanthus* and cell to cell signalling which directs development of fruiting body in this organism. In his write-up, Dale Kaiser has presented a summary of these works as he recalls his days from graduate studies at Caltech, his days as a post-doctoral associate with Jacob and Wollman in Paris, and then on to his first job at Washington University Medical School from where he moved to Stanford University, his present place, in 1959. It was a delight to read through this interestingly written yet highly motivating arti-

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cle. It was also a realization of how a sincere presentation of Ph D thesis proposal by one of his students, to the thesis committee, resulted in a missed recognition of their original contributions to the origin of recombinant DNA technology.

The next article in this book by Buckel and Golding reviews important aspects of enzymes in anaerobes that possess (free) radicals in them as cofactors. The authors avoid the use of the conventional term 'free radical' because when bound to enzyme they are not really 'free'. This article provides the much-needed information on this class of enzymes which otherwise finds a passing mention in biochemistry textbooks. The following article by Schneemann reviews structural aspects of the role of single-stranded positive sense RNA genomes in assembly of the icosahedral viruses. This is followed by a chapter by Lin and Heitman on the life cycle and effect of genotypic and phenotypic variation on virulence of another medically important agent, *Cryptococcus neoformans* which causes fungal meningoencephalitis in immunocompromised patients. The chapter on microbial metabolism of selenium and arsenic by Stolz *et al.* highlights recent advances in varied aspects of the ecology and physiology of these essential toxins. The authors point out that although both selenium and arsenic are often talked about together, their roles and requirements in metabolism are distinct.

The chapter by Barnhart and Chapman discusses biogenesis and function of Curli, the major proteinaceous component of the matrix of many members of *Enterobacteriaceae* which is implicated in pathogenesis. Interestingly, Curli are members of the amyloid class of proteins and studies on this protein are important as they provide a facile *in vivo* system to advance our knowledge on Alzheimer's, Huntington's and the prion diseases. The next chapter by Wall and Krumholz does not only tell us how microbial reduction of uranium (VI) to uranium (IV) into an insoluble form results in its bioremediation but also reveals that uranium is actually the 49th most abundant element in the earth's crust! Power of microbes is widespread; while on one hand, they are used to decontaminate uranium, on the other, they can be used in biowarfare. Recent anthrax attacks in America and elsewhere have changed the perspective of research on such organisms. Reference is being made to the article by McLendon *et al.*

who review information on pathogenesis of tularemia caused by *Francisella tularensis*. The article discusses virulence factors of this organism which impair the macrophage function and the host immune response. Appropriately, the article by Papp-Wallace and Maguire discusses the mechanism of manganese transport and its role in virulence. The article by Enjuanes *et al.* presents issues related to host-pathogen interaction and the strategies used by the coronaviruses for their replication, for which the severe and acute respiratory syndrome, SARS-CoV and mouse hepatitis virus-MHV are used as popular models.

The article by Nohmi on environmental stress and lesion-bypass DNA polymerases gives a brief account of various DNA polymerases and their specific functions in cell. A companion chapter by Kaguni discusses the role of DNAa and accessory proteins in controlling initiation of DNA replication in bacteria. Marine biology has a special place in microbiology. It provided microbiologists a glimpse of the completely unknown world of uncultivated microorganisms and the 'omics' of metagenomics. The article by Wagner-Döbler and Biebl on environmental biology of the marine *Roseobacter* lineage of bacteria, representing a phylogenetically coherent but a physiologically diverse group, reveals the huge potential of this group of bacteria. The organisms of this group transform light energy into ATP using an unusual process of aerobic anoxygenic photosynthesis (AAnP) and play an important role in global cycling of carbon and sulphur. Rappleye and Goldman sum up the recent advances in identification of virulence factors in dimorphic fungal pathogens and emphasize the utility of molecular tools including the genetic approaches in deducing molecular mechanisms of virulence in these fungi. The chapter by Ortín and Parra details the structure-based molecular mechanisms of RNA dependent RNA polymerases (RdRp) of various RNA viruses. An interesting feature of the RNA viruses is that RNA is used for multiple functions in translation, replication and transcription. And, the remodeling of RdRp by host factors plays an important role in the biology of RNA viruses.

Why are genomes of unicellular organisms especially prokaryotes smaller and simpler than their counterparts from multicellular organisms? Although there are

several hypotheses, these are not based on population genetics. How population genetics is important for this phenomenon is discussed by Lynch in a chapter on streamlining and simplification of microbial genome architecture.

Proteins are not always translocated in unfolded form. Tat, the twin arginine translocation (the signal peptide harbours a twin arginine motif) pathway translocates folded proteins across the cell membrane. Mechanisms of such a transport involving TatABC channel in *E. coli* and its variants in other organisms are discussed by Lee *et al.* This article highlights the importance of this translocation pathway in pathogenesis as also in biotechnology. The transport of the unfolded proteins that occurs via the Sec pathway gets discussed in the article by Scott and Barnett in the context of differences in the surface proteins of the gram positive and gram negative bacteria. In this series of articles on transport of cytosolic proteins, it is no surprise that the next article is on the type III secretory system (TTSS) of transport in phytopathogenic bacteria. In type III system like the type I system the proteins are transported from cytosol to the exterior without its intermediate release into periplasm (as is the case in type II system). However, unlike the type I system the secretion of proteins via TTSS occurs in response to bacterial contact with the host. TTSS is of particular interest for translocation of virulence factors to the eukaryotic host cells. A major focus of the article by Grant *et al.* is on pathogenic as well as symbiotic plant associated bacterial TTSS. Next, Claverys *et al.* discuss the fundamental differences in the mechanism of transcriptional activation of the *com* genes that code for DNA uptake and processing during transformation and emphasize that induction of competence regulons is a general response to stress in gram positive bacteria (*Bacillus subtilis* and *Streptococcus pneumoniae*). It is a programmed process to enhance fitness of the bacteria under the conditions of stress. The chapter by Roth *et al.* provides a detailed analysis of the controversy on the origin of adaptive mutations. Such mutations are thought to arise in response to stresses (which are themselves not mutagenic) as a result of activation, within cells, of mechanisms that generate mutations even in the non-growing cells. The authors discuss the available data to suggest that there is really no compelling reason to