Acta Crystallographica Section D
Biological Crystallography
ISSN 0907-4449

book reviews

Works intended for this column should be sent direct to the Book-Review Editor, whose address appears in this issue. All reviews are also available from **Crystallography Journals Online**, supplemented where possible with direct links to the publisher's information.

Biofunctionalization of Nanomaterials. Edited by Challa Kumar. **Nanotechnologies for Life Sciences**. Volume 1. Pp. xx+366. Weinheim: Wiley–VCH Verlag GmbH Co. KGaA, 2005. Price (hardcover) 139 Euro/220 SFR. ISBN: 3-527-31381-8

In the last few years bionanotechnology has attracted a growing community of scientists from biology, physics, chemistry, materials sciences, and also from applied sciences such as medicine and biotechnology. Although the interests in this new interdisciplinary field differ greatly, some common roots have been developed which are supporting the growth of the various disciplines. Biofunctionalization of nanomaterials is one of such basic topics presented in this very interesting monograph. As the title suggests the contributions are mainly focused on biofunctionalization of nanoparticles. Other nanostructures as nanorods, nanoporous membranes or thin films are not considered, the only exception being carbon nanotubes. In spite of this, the importance of bioconjugated nanoparticles for application in the life sciences and technical engineering is a good reason to devote a monograph to the subject.

A large variety of nanomaterials are covered by 11 contributions. The whole volume is process-oriented, which means that much information is provided on preparation. Aspects of the application of the various materials in the life sciences are discussed in every contribution. Also worth mentioning are the very informative and extended references in every chapter.

The editor has brought together an international group of experts to present the various aspects and techniques of biofunctionalization. The first chapter gives an overview of recent developments in bioconjugation of fluorescent nanoparticles. Dye-doped nanoparticles, quantum dots, metal nanoparticles and µm-sized hybrids comprising fluorescent nanoprobes are discussed. The design architectures of biocompatible surface coatings for fluorescent nanoparticles are explained. Representative examples of how biofunctionalized nanoprobes can be applied to problems in biosensing as well as single-cell and tissue imaging are given.

Carbon nanotubes (CNT) have been the focus of materials scientists for about ten years now. There are many ideas for their application. Among them the development of biosensors by using bioconjugated CNT is one of the most promising. Chapter 2 presents ideas for such an approach. The authors have found a very nice way of bringing together the basic materials science issues with an overview of various options of biofunctionalization. The discussion of CNT substrates for neuronal growth could be interesting for tissue engineering.

Magnetic nanoparticles have already had a well established place in the life sciences for many years. More recently, novel synthetic routes for preparation of magnetic particles with tailored coatings, crystallinity and size uniformity have enlarged the number of biomedical applications. Biofunctionalization for protein and cell separation, biochemical synthesis of therapeutic drugs and *in vivo* bioimaging, drug targeting and tumor hyperthermia treatments are presented in the third chapter.

In a separate chapter the preparation of magnetic core conducting polymer shell nanocomposites for DNA attachment and hybridization is presented. By controlling the size and shape of the gold nanoparticles their optical properties can be changed in a well defined way. This makes them interesting for many applications for various kinds of biosensors. Depending on the kind of biofunctionalization and the preferred optical detection method, various sensor arrays for DNA, proteins, cells and viruses can be developed.

The outstanding place of bioconjugated gold clusters is also expressed in two chapters devoted to 'Biofunctionalization of metallic nanoparticles and microarrays for biomolecular detection' and 'Conjugation of nanomaterials with proteins'. Whereas the first mainly concerns the functionalization with DNA, the latter describes the coupling and assembly of proteins and nanoparticles (metal, semiconductors and nanotubes). The formation of supramolecular structures by self-assembling of DNA or proteins is one of the most interesting features of both approaches. The chapter concerning the functionalization of metallic nanoparticles by using the peptide route is one of the highlights of the book. The concept of a peptide toolbox containing capping ligands, recognition and self-assembly motifs is introduced. A major advantage of the peptide route is stabilization and functionalization in a single step. This kind of functionalization allows the nanoparticles to be converted into a protein-like material. Thus, a large range of new applications of metallic nanoparticles in the life sciences and in technical engineering should be possible in future by using this straightforward design principle.

Finally, there are two chapters with applications on medical therapy: 'Folate-linked lipid-based nanoparticles for tumor-targeted gene therapy' and 'Gelatin nanoparticles and their biofunctionalization'. Biofunctionalization should help to improve the targeting as well as the release functions at the target place. These two chapters would be of interest mainly to readers engaged in clinical applications.

Altogether, the book offers a wonderful survey of new developments in bioconjugated nanoparticles. The larger part of the book could serve as a beautiful textbook for teaching bionanotechnology in masters programs. Some chapters would

be most useful for senior researchers only. Finally, I would like to emphasize that this topic is not only of relevance for application in the life sciences but also offers a lot of ideas for technical engineering.

Wolfgang Pompe
Professor fuer Materialwissenschaft und Nanotechnik
Institut fuer Werkstoffwissenschaft
Gebaeude Hallwachsstrasse 3
Technische Universitaet
D-01062 Dresden
Germany