radiation (like UV, X(35 kV, 10 nA) and γ-(CO^{60})-rays) and heating at a rate of 20°/min up to 500° C. The glow peaks in general increase with irradiation time in all cases. The observed behaviour is influenced by both the intrinsic defects like traps present in the lattice as well as by the doped impurities or both. The last paper in this section deals with the use of 3 mol% Bi_2O_3 as a liquid phase sintering aid to obtain high density (>95% TD), zero open-porosity ZrO_2–10 mol% Y_2O_3 conducting bodies (at 1375 K) which find application as solid electrolyte oxygen sensors. The advantage of this sintering aid is that it is a good oxide ion conductor (having negligible electronic conduction) with a low melting point (1125 K) so that it effects the sintering at this low temperature and could be evaporated off after densification leaving behind only traces of Bi(III) oxide which does not affect the electrical conduction behaviour of the zirconia–yttria system.

The section on Cutting Tool, Abrasion Resistant and Machinable Ceramics has four papers. The first one presents the results of a comparative study of alumina, sialon and tungsten carbide tools for machining grey cast iron. The results presented are broadly comparable. At machining speeds of 200 m/min, maximum tool life was achieved for sialon tools (13 min); at 140 m/min, it was alumina which performed better (15 min); while it was 10 min for WC tool-bit for the same speed (140 m/min). The tool life exponent for the materials were 0.89, 0.74 and 0.52 respectively for sialon, alumina and WC. A succeeding paper presents the wear behaviour of alumina ceramic cutting tools in the machining of mild steel and cast iron work pieces. While the main wear was found to be flank wear due to abrasion, crater wear due to spalling and catastrophic failure due to brittleness of the tool and the nonrigidity of the machine/tool are also occasional. These tools exhibit a higher resistance to wear compared to WC tools at higher cutting speeds owing to the retention of hardness and compressive strengths of the former at higher temperatures. A paper on ceramic and thermal processing of alumina powders for developing abrasion-resistant high alumina ceramic materials for use as mill-liners and as grinding media has been included, keeping in view, the effect of grain size and pore size on the microstructure and thereby on the mechanical strengths and abrasion resistance. To have homogeneous distribution of small pores, the optimized condition of powder processing as well as the sintering conditions (1500–1550° C) of the formed body are important. The last paper in this section describes the development of a machinable glass ceramic (flour-mica) in the system K_2O-SiO_2-MgO-Al_2O_3-F through a melt and gelation route. It has properties comparable with commercial 'Macor'.

The section on Ceramic Coatings contains three articles, two devoted to plasma-sprayed coatings and one to thermal-rod sprayed coatings. Plasma spraying of zirconia powders on various metallic substrates is reviewed in the paper by Mustaq Babi in regard to the salient features of the plasma flame and its augmentation and manipulation by a control of various contributive parameters. The application areas of these coatings are indicated. A more general paper on plasma spraying of ceramic powders by Elayaperumal describes the use of a 'plasmadyne' gun to obtain plasma coats of various materials like alumina, chromia, titania, carbides, etc. and the scope for application of these coatings on a variety of components whose wear, corrosion and high temperature resistance would be enhanced by these coatings. The last paper in this section deals with the use of the technique of oxyacetylene flame spraying of ceramic coatings using sintered ceramic rods as the source of ceramic spray. The paper deals with the use of Norton's high velocity (200 m/s) Rokide oxyacetylene flame gun to obtain highly consistent coatings of alumina, chromia, alumina–titania, partially stabilized zirconia, etc. to obtain high wear and corrosion resistant as well as electrically and thermally insulating coatings of industrial importance.

The last section of the book presents a report on the panel discussion organized during the conference on the prospects of the use of advanced ceramics in the Indian industry. Specialists from industry, academic institutions and R&D labs participating in the discussion stressed the need to develop both R&D bases (in the academic institutions and R&D labs) and production capability bases (in the industries) with a substantial interfacing and interaction between them to promote the advanced ceramics activity in the country.

The book on the whole provides an interesting survey of the behaviour of several advanced ceramic materials which have become important in recent times and their utilization and provides a window for highlighting of some of the current activities in the country in the area of advanced ceramics.

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Industrial Biotechnology. V. S. Malik and P. Sridhar eds. Oxford and IBH Publishing Co., Pvt. Ltd., 66, Janpath, New Delhi 110 001. 1992. 621 pp. Price: Rs 695.

The presentations during an International Symposium on Industrial Biotechnology have been presented in a book form by Malik and Sridhar. There are seven chapters in the book dealing with general introduction and trends, industrial strain improvement, molecular biology of industrial organisms, engineering of industrial organisms, industrial enzymes and biocatalysts, fermentation technology, biotransformation and biodegradation, and miscellaneous antibiotics.

Ramachandran's introductory presentation gives an excellent bird's-eye view of this subject. This is followed by three very informative articles by Gorman, Malik and Lillehaj, and Ghosh.

Presenting a chemist's point of view, Gorman narrates the shifting patterns of disease, a shift in the cures from secondary to primary metabolites and novel classes of drugs made possible by biotechnology. The spread of these classes beyond the realm of drugs into diagnostics, agriculture, environment and bulk chemical production is also narrated. He has also drawn attention to the exciting possibilities of biotechnology-based drugs and the mammoth projection of potential markets.

Malik and Lillehoj have briefly des-

cribed the differences in animal, microbial and plant systems. This is followed by an impressive account of the advances made in a variety of ways to translate basic scientific knowledge to useable technology. Various techniques devised for bringing about this translation have been described. They have also narrated the impact of biotechnological research in diverse fields such as biocatalysts, energy, crop improvement and protection, bioactive molecules, gene therapy and embryo transfer technology, concluding with remarks on how this emerging field will help the third world.

In an extremely informative and well-illustrated article Ghosh has presented opportunities available to Indian industry in the field of biotechnology. Enumerating case studies in different fields such as diagnostics, vaccines, antibiotics, bioactive molecules, aquaculture, horticulture and industrial enzymes, Ghosh has unfolded investment opportunities for biotechnological industry in India. The accuracy of his projections is evident from the fact that during the brief period of his presentation of the forecasts and the publication of the book, industry has already moved in; whereas products like detergent enzymes have reached the market place, other areas are at different stages of progress.

Ghosh has a word of caution about the long lead times between scientific discoveries in biotechnology and their commercialization. The high interest rates in India added to the high risks for novel products and long lead times are discouraging factors for industry to move in. He foresees quicker success if pilot scale experimentation and validation is meticulously worked out to cut the lead time. A number of mechanisms exist today with funding support from financial institutions, NRDC, DBT, etc. for sharing the risk in such validation without much visible impact. Ghosh has also made an important point that investors will have to take venture risks now, as in future, the costs of procurement of off-the-shelf technology will be enormous and often, the state-of-the-art technology will not be available for purchase.

The success story of concerted efforts aimed at strain improvement for the antibiotics industry is narrated by Rowlands. Although we have a number of collaborative research associations in India in several groups of industries it is sad to see that all major fermentation industries have to go out for inducting improved strains every once in a while. As pointed out by Ghosh, the best yielding strains are not always available. India could do well to get over this area of weakness by a get together of our numerous breweries, distilleries, antibiotics, industry and the like. The upgradation of penicillin productivity from 2 units/ml to 100,000 units/ml is indeed quite an achievement. By and large strain improvement still appears to follow the classical course of subjecting strains to chemical and physical methods of mutagenesis. Jain has described some attempts at creating genetically engineered strain of cellobiohydrolase. Bajaj in his article has decribed some of the precautions that need to be taken in optimizing the conditions of upscaled fermentations with improved strains.

Proteins as naturally occurring biologically active molecules generally suffer from the weakness of low stability at ambient temperatures. Suzuki has given an excellent presentation tracing the conditions leading to stabilization of proteins and opened up the possibility of getting over this weakness when one attempts to make them using genetic engineering techniques.

Even after successfully cloning a gene leading to desired protein synthesis two obstacles remain. The synthesis is not efficient unless the synthesized molecule is transported across the membrane into the medium. Secondly, having secreted into the medium, it needs protection from proteases which are often also secreted into the medium by the cells. Strategies involved in transport and protection from proteases are described in an article by Takagi.

Schumacher *et al.* describe the cloning and large-scale production of creatinase which meets all the requirements of a product useful in a complex clinical diagnostic kit. In the same chapter on industrial enzymes and biocatalysts, Vandamme has dealt with penicillin and cephalosporin acylases, their production and immobilization and Jensen deals with lipases useful in the detergent industry.

The chapter on fermentation technology includes various aspects of the subject such as design, scale up and mathematical modelling of fermenters, precautions in operation and some new directions including upscaling of plant cell cultures for producing rare phytochemicals.

Some of the opportunities available to us for export of products need proper logistic support as in the field of horticulture described by Reddy.

Other articles of interest include that on the potential of drug targeting using gene fusion by Soria, on protoplast fusion by Deobagkar and expression of insecticidal protein genes by Komano *et al.* The book also includes contributions on biotransformation and biodegradation and a number of miscellaneous presentations made during the course of the Symposium.

In the Indian context, the book indirectly brings home several messages. Perusal of the article on biotechnology application in Kuwait makes us conscious of our strengths built up in this country in this young branch of science and the opportunities we can have in exploiting the markets in the developing world. It also reminds us of our weaknesses in exploiting the capabilities of microbes, even if we created good new ones, and the existing need for manpower development in fermentation technology. One of the tragedies in this country—thanks to our present day value system—is that there is too much emphasis on basic research (upstream) and very little on application of knowledge gained for social benefit. It will be unfortunate to see some day, that we are required to import finished products which were made in the developed world, exploiting the fruits of basic researches conducted here.

The book might be of interest to policy makers as also to decision makers in industry thinking of diversifying in this new branch of science.

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Nervous Systems—Principles of Design and Function. R. N. Singh, ed. Wiley Eastern Ltd., 4835/24, Ansari Road Daryaganj, New Delhi 110 002. 1992. 506 pp.

This book is a collection of papers that were presented at the second International Conference on Neurobiology