Analytical biotechnology
Editorial overview

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Biotechnology is booming. Advances in science and technology are taking place on all fronts — from academic and government research institutions where biological information is being produced in quantities that were not thought possible only a decade ago, to emerging companies challenged with the task of rapidly developing and commercializing scientific discoveries, to established life science companies, which now implement research and development with industrial scale efficiencies. This breathtaking pace is largely due to the development of new analytical tools, and has been pushed into an even higher gear by the inspiring idea of the Human Genome Project. While in the past, advances in analytical biotechnology emphasized those accomplishments that held promise as enabling technologies, today emerging techniques are put to an immediate test. Advances in biotechnology are now made through the parallel events of experimentation, data generation and innovation in analytical techniques. In this issue of *Current Opinion in Biotechnology* we have assembled articles that give an overview of the current state of bioanalytical tools and techniques, and their contributions to the advancement of biology and medicine.

In the year 2000, we witnessed a milestone in the international effort to sequence the human genome. As we approach a time when total nucleic acid sequence information is available for humans as well as other animals, plants and organisms, the development and deployment of techniques to investigate those sequences has exploded. A majority of the articles in this issue are devoted to techniques for the analysis of nucleic acids.

Banér *et al.* (pp 11–15) describe developments on padlock DNA probes that have wide implications in the field of high-throughput analysis of nucleic acids. Peptide nucleic acids (PNA) as reviewed by Nielsen (pp 16–20) are discussed in methods for high-throughput analysis of nucleic acids as well as in methods for *in situ* hybridization, DNA targeting and PCR clamping. A review of molecular amplification methods, the diverse ways in which these methods are applied and their relevance to detection are discussed by Schweitzer and Kingsmore (pp 21–27). The ability to perform large-scale mutagenesis in a eukaryotic organism and its consequences on our understanding of the function of the DNA-encoded information is described for yeast in the article by Vidan and Snyder (pp 28–34), demonstrating the power of such genome-wide approaches.

The review by Scheller *et al.* (pp 35–40) provides a glimpse into the diversity of the analytical procedures on which biosensors are based, and presents the emerging applications of sensor-based nucleic acid detection and biomimetic sensors. Blohm and Guiseppi-Elie (pp 41–47) briefly subsume developments in the powerful and currently widely applied field of DNA-microarray technology. The reviews of van Berkum and Holstege (pp 48–52) and Tillib and Mirzabekov (pp 53–58) provide more detail on aspects of array-based nucleic acid analysis and elaborate on the use of microarrays for transcriptional profiling and advances in genotyping.

Array-based techniques have recently been extended to the analysis of peptides and the differential profiling of proteins. The article by Reineke *et al.* (pp 59–64) presents advances in peptide arrays for the study of protein binding and epitope mapping. Fung *et al.* (pp 65–69) present protein chips developed for the analysis of differential protein expression in normal and disease states, particularly in the areas of cancer, infectious disease, and toxicology.

This issue of *Current Opinion in Biotechnology* includes two articles that present bioanalytical techniques developed for the interrogation of living cells. The manuscript by Slater (pp 70–74) provides a review of high-throughput techniques for evaluating cytotoxicity, including advanced methods directed at intracellular processes that lead to apoptosis. Taylor *et al.* (pp 75–81) presents techniques for the real-time, spatial analysis of molecular processes within living cells.

Two manuscripts demonstrate the advantageous, integrative aspects of a parallel application of analytical techniques in the study of complex biological systems. The manuscript of Fiehn *et al.* (pp 82–86) presents a combination of multiple analytical techniques and bioinformatics tools directed at the complete understanding of plant function. Delneri *et al.* (pp 87–91) provide an integrated view of biology at the level of the whole organism through their discussion of the functional genomics of yeast.

Placed at the end of this issue of *Current Opinion in Biotechnology* is a selection of articles devoted to advances in the development of integrated devices. In these articles, we see the marrying of assay methods, sensing

techniques and automation in a common device. Progress on microfabricated reaction and separation systems for the analysis of nucleic acids, proteins and cells is presented by Krishnan *et al.* (pp 92–98), with an emphasis on efforts to construct fully automated 'lab-on-a-chip' systems. D'Auria and Lakowicz (pp 99–104) elaborate on the perspectives of enzyme fluorescence as a sensing tool, an issue directly related to the problem of sensitivity and accuracy. In the text of Kyranos *et al.* (pp 105–111), advances in mass spectrometry for the high-throughput analysis of organic synthesis products and biological samples are discussed, along with the implications of these advances for drug discovery.

Hopefully, the bioanalytical tools and techniques presented in the following collection of articles will prove useful in the advancement of biology and medicine, and will stimulate the development of even more advanced methods in analytical biotechnology. We wish to thank all of the contributing authors and to acknowledge the editorial staff of Elsevier Publishing for their support and input to this issue of *Current Opinion in Biotechnology*.