

Preface

I am very pleased to present this volume on engineering stem cells in *Advances in Biochemical Engineering and Biotechnology*. This volume stays abreast of recent developments in stem cell biology and the high expectations concerning the development of stem cell based regenerative therapies.

Regenerative medicine is the focus of current biomedical research, with unique challenges related to scientific, technical and ethical issues of stem cell research, and the potential added value of connecting biomedicine with enabling technologies such as materials sciences, mechanical- and nano-engineering. Research activities in regenerative medicine include strategies in endogenous regeneration of injured or degenerated tissues by means of gene therapy or cell transplantation, as well as complex approaches to replace or reconstruct lost or malformed tissue structures, by applying tissue engineering approaches. In most cases, the specialized functional cell types of interest cannot be isolated from the diseased organ or expanded to a sufficient degree, and various stem and progenitor cell types represent the only applicable cell source.

In almost all cases, stem cells have to be engineered, sometimes for functional improvement, in many cases to produce large numbers of cells, and frequently to achieve efficient and specific differentiation in the cell type(s) of interest. Engineering stem cells can take place on different technological levels including genetic manipulation, treatment with growth factors and small molecules and seeding on functionalized nanostructured surfaces or culture in 3-dimensional matrices, as well as static or continuous mass culture in various types of bioreactors. The mode of engineering depends critically not only on the functional cell type that needs to be generated, but also on the necessary cell number and the stem cell type that is used. Prior to clinical application, GXP-conform protocols have to be developed and potential risks such as tumour formation have to be assessed and minimized.

To prepare this volume, contributions from leading researchers and experts in specific fields of basic and applied stem cell research were assembled. In particular, the technological aspects of stem cell research, including critical discussion of technical limitations, are the focus of most contributions. They address important aspects, including isolation of adult and embryonic stem cells, generation of pluripotent cell sources by means of reprogramming, differentiation of stem cells,

purification of stem cells and their derivatives, and the development of large scale culture protocols. Recent developments in stem cell-based tissue engineering round off the volume.

I hope that this volume will be useful not only to stem cell researchers but also to investigators in related fields, including physicians, chemists and engineers, who intend to enter the field of stem cell research. In addition, I anticipate that it will provide basic reading material for students starting their research in the field of stem cell biology and regenerative medicine.

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Ulrich Martin

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