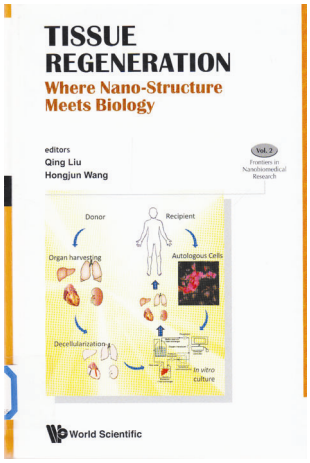


Tissue Regeneration: Where Nano-structure Meets Biology, Vol. II. Qing Liu and Hongjun Wang (eds). World Scientific Publishing Co. Pte Ltd, 5 Toh Tuck Link, Singapore 596224. 2014. xl + 492 pp. Price: US$ 145.

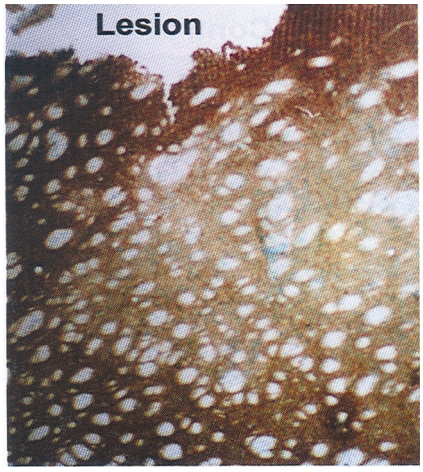
Tissue loss and organ failure caused by the significant increases in ageing population and trauma through accidents have necessitated tissue and organ transplantation. These treatment options are hindered on account of a critical shortage of donor tissues and organs, besides being extremely expensive. Tissue engineering, an integrated science and engineering discipline aimed at creating functional tissues and organs for transplantation, has been evolving into one of the most promising therapies in regenerative medicine. The essential elements of tissue engineering are the cells, biomaterials and biological cues that interplay and determine the size, shape and functionality of the resulting engineered tissues. The authors of this book are all active researchers and leaders in their field. The book covers a wide range of clinical applications and is organized into the following research areas: Stem cells for tissue regeneration, Nano-structured biomaterials for soft tissue regeneration, Nano-structured biomaterials for hard tissue regeneration and Cell interactions with nano-structured biomaterials.

In the first chapter on the theme of stem cells and sources for tissue regeneration, the authors H. E. Young *et al.* have discussed in great detail the various possibilities of adult stem cells. An exhaustive review of all aspects of these cells ranging from their classification, isolation, cultivation, characterization and cryopreservation form an excellent backdrop for their subsequent discussions on pre-clinical and clinical scenarios. The authors present valuable insights into the development of a pre-clinical animal model for Parkinson's disease, which they could also extend to a bedside phase or efficacy trial for Parkinson's disease in humans. While the results of the trial open the possibility for the usage of the potential autologous cells to regenerate tissues, there is however, no direct relevance to the book's title, namely where nano-structure meets biology.

Preparation of tissue development – mimicking matrices and their applications is the title of the second chapter by G. Chen *et al.* Here the authors refer to a well-understood topic of the natural extracellular matrices (ECM) surrounding the cell *in vivo*, and responsible for controlling cell function and supporting the cell to form specialized tissue architecture. ECM that mimic the dynamic changes during stepwise tissue development and further used for stem cell research are detailed. Although these matrices could be useful in the future for regulation of stem cell differentiation, they do not promise to form specialized tissue architecture, and also lack mechanical strength and ability for 3-dimensional modelling. It was expected that the authors would throw some light into the use of similar matrices like the decellularized tissue, but this was not so. However the third chapter by S. S. Patnaik *et al.*, specifically discusses the issues of decellularized scaffolds which are again ECM. The authors discuss the preparation of such scaffolds and some applications such as cardiac tissue regeneration and whole organ tissue engineering. While some such scaffolds have been granted USFDA approval for certain pre-clinical animal and human studies, mostly in the wound regeneration area, and there is a possibility of achieving multiple hierarchical levels of tissue organization in tissue engineered organs, the challenge for such whole organ regeneration is still regarded very high.

Chapters 4 and 5 by Bing Ma *et al.* and M. Mozafari *et al.* respectively are state-of-art reviews on the techniques for making nanofibrous scaffolds via the electrospinning process. Several well-illustrated examples of the possible variations in morphologies of electrospun scaffolds form part of these reviews and could well be termed as next generation electrospun scaffolds. The section of utilization of such scaffolds in the repair and regeneration of diverse tissue types is a valuable addition to chapter 4 which could be of immense interest to the researchers of this field of 'nano-structure meeting biology'. Chapter 6 by Qing Liu and M. K. Bergenstock discusses a relatively simple technique to obtain a bioactive coating for a synthetic scaffold. The technique involves culture of cells on a scaffold allowing the cells to secrete their ECM and further decellularization of the construct to obtain a cell free coated scaffold which could further be used to grow the cells or tissues of interest.

Chapter 7 is an interesting review by S. V. Dorozhkin which deals in detail on the definition of the nanodimension. The synthesis and characterization of nanodimensional and nanocrystalline calcium orthophosphate materials are dealt with in great detail. The author emphasizes the importance of the synthetic protocol of the nanomaterial in defining the biological responses in specific examples of bone and dental repair and regeneration. Other aspects of biomedical application like controlled delivery of drugs, genes and other biologics as well as some imaging applications are covered in this review. Y. Liu *et al.* review the bioceramics and glasses specifically used as coatings for orthopaedic implants or as scaffolds for bone regeneration. Aspects of improved bioactive ceramics to promote osteogenesis, angiogenesis, anti-infection and controlled drug delivery are also mentioned in the review.



Hemi-brain of adult rat stereotactically injected with ascorbate buffer containing 6-hydroxydopamine.

Electrospinning and its promise in delivery of nanostructures that are akin to the ECM morphology appears to have influenced the trends of research in biomaterials significantly. The influence of varied electrospun nanostructures on the cellular response of cells is hence dealt with in Chapter 9 by P. Madurantakam and G. Bowlin and X. Chen *et al*. in Chapter 10. The authors of both these reviews attempt to elucidate the molecular mechanisms wherein key attributes of electrospun structures such as fibre diameter, alignment, porosity, etc. may dictate the cellular responses such as promotion of cell attachment and spreading, enhancement of cell migration and proliferation, and maintenance of cellular phenotype.

D. Barbieri *et al*. discuss the theme of surface features like roughness and stiffness of nanocomposites being utilized to understand the cellular responses *in vitro* and *in vivo*. In this chapter after an initial review of the effect of roughness in studies of the interface, the authors further focus on their own study with nanocomposites of varied roughness in bone regeneration. While they had substantial responses in the *in vitro* studies, they also report that their experiences in the *in vivo* studies with the same materials were not as encouraging. They conclude that *in vitro* systems with biomaterials may not be a true reflection of the *in vivo* performance of the material.

Although a lot of useful information on nanomaterials and tissue regeneration are presented in great detail, there is a lot of repetition of the concepts. A clear perspective on what could be a distinct influence of nanostructures in guiding the fate of tissue regeneration fail to emerge and is left to the imagination of the reader. Nanomaterials are also expected to generate undesirable responses of toxicity in the biological milieu by virtue of their size and other unique features. Such features are still under study. However, none of the authors of this book have touched on this aspect and that could be a limitation of this otherwise useful book.

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