

Preface

I teach two classes, an introductory and an advanced class in tissue and organ fabrication. My introductory class, called Introduction to Tissue Engineering, is designed for senior undergraduate students and first year graduate students. This class covers fundamental topics in the field and includes cell sourcing, biomaterial synthesis, tissue fabrication, bioreactor technology, and vascularization. My second class, called Advances in Organ Fabrication, is designed for graduate students pursuing research degrees in the field of tissue and organ fabrication; the introductory class serves as a prerequisite for the graduate class. The advanced class is designed to transition from tissue fabrication to organ fabrication – *how can we use our understanding of the tissue fabrication paradigm to design process schemes for organ fabrication?* This class is coupled with an in-depth project where students are required to research any given tissue/organ system and address the following tasks: (1) explain current state of the art through a detailed literature review, (2) identify technology gaps in the selected tissue/organ system, and (3) design specific experiments to overcome these technology gaps.

This book has been divided into seven chapters. In Chap. 1, I start with an overview of the field of organ fabrication and introduce important concepts as they apply to the organ fabrication process. In Chaps. 2 and 3, I cover sensor technology and genetic engineering respectively and the importance of these topics during tissue and organ fabrication. Chap. 4 is focused on cell therapy for the heart and describes the current state of the art in stem cell engineering. With this foundation in place, Chaps. 4–7 are focused on specific aspects of the cardiovascular system, starting with the heart muscle (Chap. 5), then biological pumps (Chap. 6), and finally bioartificial ventricles (Chap. 7). These four tissue and organ systems have been selected to illustrate specific challenges in moving from planar 3D tissue systems like heart muscle to more complex hollow chamber systems like biological pumps and further extending the degree of complexity to bioartificial ventricles.

This book has been written with students in mind and, therefore, has many features to aid the educational experience of students. Every chapter begins with a chapter overview and clearly defined learning objectives. Two or three critical concepts are covered in every chapter, and these are defined at the beginning of each chapter. The material is presented in a simple and easy-to-read and easy-to-follow format. Numerous color illustrations have been custom-created to enhance the learning experience. A summary is included at the end of every chapter. Open-ended discussion questions are included for students to extend their thinking, and a detailed reference list has been included to encourage further research and reading.

One of the hallmarks of this book is the discussion of specific case studies. Throughout the course of this book, 22 in-depth case studies have been presented. The purpose of these case studies is to present specific design schemes for tissue and organ fabrication; each case study has been carefully selected to illustrate a specific aspect of the tissue and organ fabrication pathway. Many case studies have been presented based on research at the author's lab; the main reason for including these is my in-depth technical knowledge

about the specific tissue/organ system and details of the scientific study. Many case studies have been presented based on research by other research groups; in these stances, the material has been presented based on my understanding of the material and has not been reviewed or endorsed by anyone (including authors of the published studies). As such, I assume full responsibility for the material presented in these case studies. In presenting these case studies, I have tried my best to present an accurate overview of the technology and the relationship of this material to specific concepts that have been presented throughout the book.

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