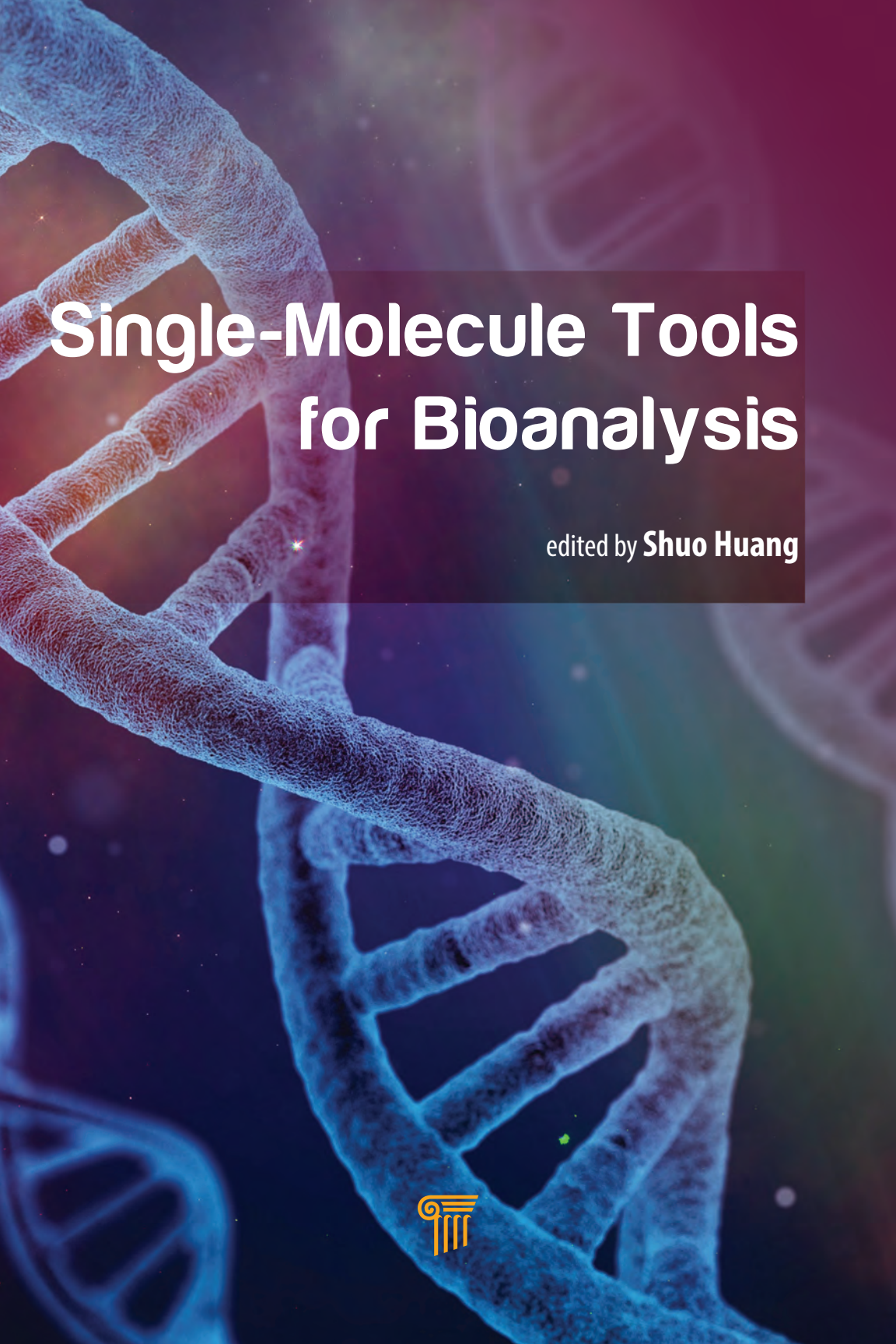
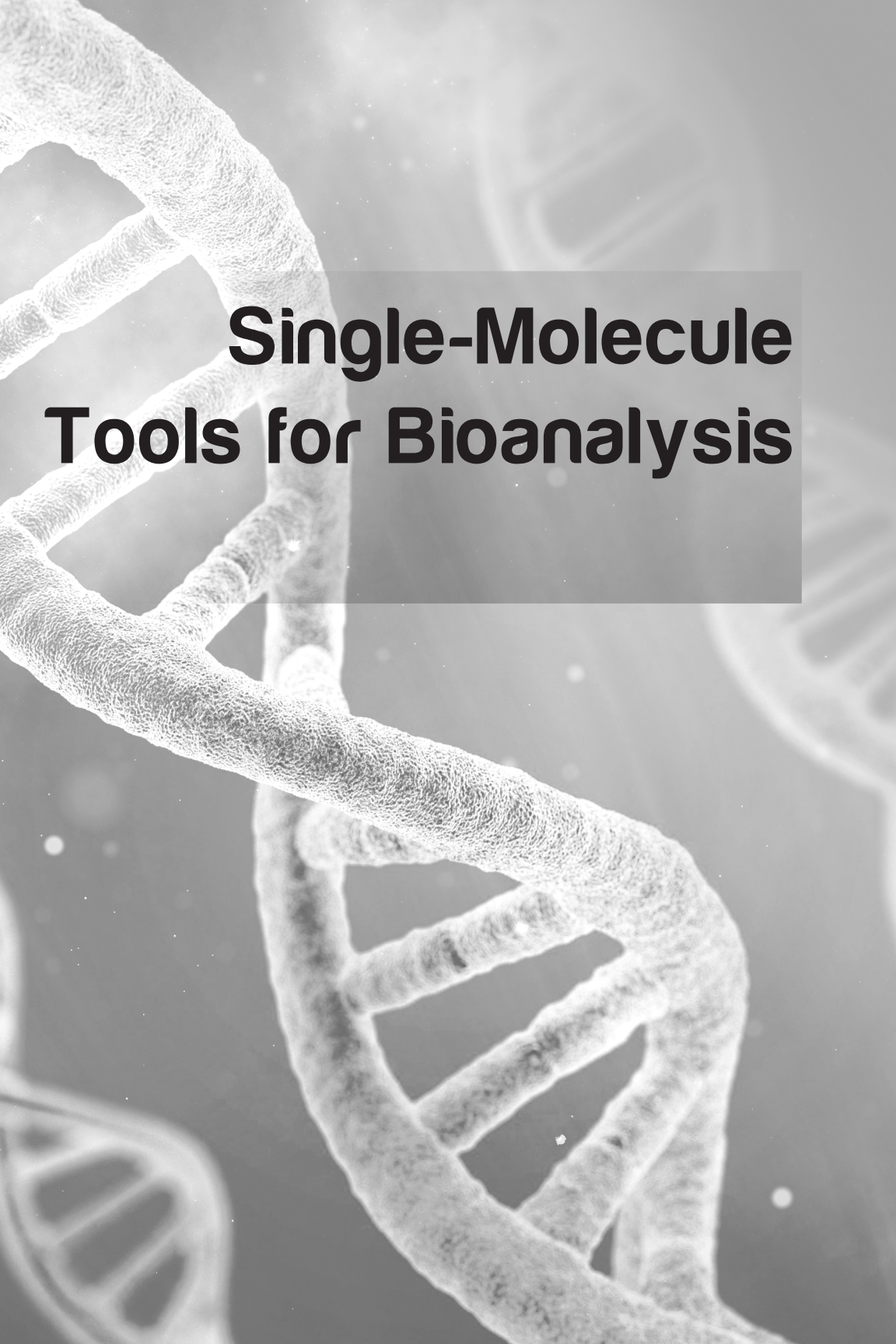

Single-Molecule Tools for Bioanalysis
edited by Shuo Huang



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Preface

Single-molecule biophysics research is a highly interdisciplinary study that requires diverse expertise in biology, chemistry, physics, and engineering, aiming to understand biological processes at single-molecule level against ensemble averaging. Investigations of single-molecule biophysics have enabled direct measurement of single-molecule properties that were not even previously feasible by any ensemble methods. These achievements include, but are not limited to, direct measurement of the elastic property of an individual strand of nucleic acids, direct manipulation of nucleic acids or protein molecules, optical imaging of cellular processes in a nanometer resolution, direct torque measurement of a supercoiled DNA, and several others. The fast development of the field has also stimulated the invention and evolution of a large variety of emerging single-molecule tools, which have enabled new concepts and applications of bioanalysis.

Though there is an urgent need to systematically summarize these achievements, it is too much for any individual review article to achieve a full coverage with sufficient details. Written by young experts in the field of single-molecule research, this book aims to provide a systematic and in-depth recap of representative topics of single-molecule bioanalysis. The book contains six chapters that cover topics on nanopores, optical tweezers, single-molecule FRET, DNA origami sensors, magnetic tweezers, and ABEL trap. Each chapter provides the general concept and a brief history of the methods, technical fundamentals, diversified forms of the methods, and the representative applications of the methods. This makes the book ideal as a textbook for a graduate-level course. In fact, the materials in this book were indeed summarized from the lecture notes of a graduate course supervised by the book editor at Nanjing University since 2015.

To make each chapter appealing to entry-level readers, a highly simplified tutorial protocol is also provided at the end of each chapter. The design of these protocols may be far from the actual measurement performed in the relevant scientific publications. They were, however, designed so that it can be finished by even undergraduate students or most graduate students with highly accessible scientific materials. Owing to the deficit of time, a few interesting topics such as electron microscopy, super-resolution microscopy, and scanning probe microscopy could not be covered. However, they are likely to be included in the future editions of this book.

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I would like to thank Dr. Mark Ian Wallace (King's College of London) for his suggestion to write this book. I would also like to thank the whole editorial team for their support during the preparation of this book. In particular, I would also like to thank Jenny Rompas and Stanford Chong, the publishers, for their support and encouragement during the book writing. I would also like to acknowledge Arvind Kanswal for the editorial support. The efforts of all chapter authors are also highly acknowledged.

"This timely book provides brief and comprehensive descriptions of how single-molecule tools can be utilized in biological studies. The authors are active experts who not only developed unique single-molecule techniques but also contributed to many aspects of biological sciences. The principle, demonstrations, applications, progress, and protocols of the single-molecule tools are useful for both researchers in the field and those who want to learn about single-molecule biology."

Prof. Xinghua Zhang
Wuhan University, China

"This book comprehensively introduces some of the most advanced single-molecule techniques written by renowned scientists. It may serve as an excellent textbook for students, researchers, and engineers."

Prof. Pengfei Wang
Shanghai Jiao Tong University, China

"Written by world-renowned experts, this book provides a complete introduction to a few widely used single-molecule bioanalytical techniques, focusing on both the fundamental mechanisms and their practical protocols. It is certainly beneficial to the scientists outside this field to learn these techniques and design single-molecule measurements to tackle the questions they are interested in. Graduate students should read this book before they decide to enter this exciting field."

Prof. Yi Cao
Nanjing University, China

"The book provides sufficient details to guide readers to carry out nanopore measurement for their own research."

Prof. Jie Yan
National University of Singapore, Singapore

"In this book, one will find the most exciting and recent developments in single-molecule techniques for advancing biomolecule analysis. This book is informative and comprehensive for students and general readers."

Prof. Jinglin Fu
Rutgers University, USA

In the last three decades, the fast development of single-molecule techniques has revolutionized the way we observe and understand biological processes. Some of these techniques have been further adapted as tools for bioanalysis. This book summarizes and details the frontiers of the development of these tools as well as their applications. The contributors are young and established researchers in their respective fields. The main content also originates from the lecture notes of a chemistry graduate course taught by the book editor at Nanjing University. This book is suitable to be used as a textbook for a high-level undergraduate or an entry-level graduate course. The systematically written content provides a thorough illustration of the mechanisms of each methodology presented.

Shuo Huang obtained his BS in physics from Nanjing University, China, in 2006 and his PhD in biophysics from Arizona State University in 2011. From 2011 to 2015, he was a postdoctoral fellow at the University of Oxford. In 2015, Prof. Huang joined Nanjing University, where he is professor at the School of Chemistry and Chemical Engineering, State Key Laboratory of Analytical Chemistry for Life Sciences, Chemistry and Biomedicine Innovation Center (ChemBIC). His research focuses on the development of single-molecule sensing tools based on biological nanopores.

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