Preface

Biomolecules are responsible for various dynamic biological functions ranging from the intracellular to the whole body and brain. Recently developed molecular and cellular biology techniques have allowed biomolecules involved and their roles to be identified. Snapshots of atomic structures and molecular organization of these identified biomoledules, which have been determined using structural biology techniques, have been foundation for understanding the mechanism of their functions. The dynamic behavior of biomolecules, which is essential for the functios, is often inferred from static and average data.

Alternatively, single molecule measurements have been developed to directly measure the dynamic behavior of single biomolecules, which is hidden in average signals that originate from a large number of molecules, which is the case for previous ensemble measurements. Single molecules can be traced while they are working in biological environments. Furthermore, high resolution, reaching the scale of nm, msec and pN, has enabled the unitary events within a molecular function to be measured. For example, the step movement of molecular motors was observed while the motors hydrolyzed single ATP molecules. Single molecule imaging has been used to monitor the dynamic changes in location, structure and interactions of biomolecules in several complicated systems such as molecular machines, organelles and cells leading to significant progress in clarifying the fundamental principles driving cellular functions. With continued progress, we believe that single molecule measurements offer the promise of disclosing the fundamental principles behind biological dynamics.

It has been more than a decade since both single fluorophores attached to biomolecules were detected in aqueous solution and single biomolecules were manipulated. Since then, single molecule measurements have become common tools in a large number of laboratories. However, there is still much that needs to be accomplished. The technology is still immature as new techniques, such as new probes, are needed. Forging single molecule measurements with other fields like nanotechnology will be instrumental to further develop single molecule detection and potentially enable single molecule detection to be applied throughout the whole body. We hope that this book serves as a steppingstone for the next generation of

Single Molecule Dynamics in Life Science. Edited by T. Yanagida and Y. Ishii

ISBN: 978-3-527-31288-7

single molecules measurements, as readers will find information that will guide them to developing future techniques, subjects, strategies and goals.

Finally, we would like to thank all the authors for their valuable contributions to this book. Each is a pioneer for single molecule measurements in their respective biological field. We would also like to thank the staff of Wiley-VCH, in particular Dr. Rainer Muenz, for their help and encouragement.

August 2008

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