

Preface

Biophysics and biochemistry are undergoing a revolution with the development of new tools and techniques to manipulate and observe single molecules and their interactions. In this monograph, our purpose is not to present a comprehensive review of this vast and rapidly expanding field, but rather to introduce these novel techniques and exemplify their use in the study of nucleic acids and their interactions with proteins. In other words, our goal is to provide an introduction to the main techniques which are used to study single molecules, both via their manipulation and visualization, to allow the reader to understand the concepts behind these methods.

We discuss in detail the mechanical properties of nucleic acids, where a comprehensive understanding was achieved thanks to the use of single-molecule manipulation approaches. This agreement between theoretical models and observations has set the stage for the single-molecule study of the interaction between nucleic acids (DNA or RNA) and their associated proteins.

While we will not review this quickly expanding area, we will exemplify the use of single-molecule manipulation and visualization methods in the study of some specific DNA motors: DNA and RNA polymerases, helicases, and topoisomerases. Our purpose is to show that these techniques can open up new vistas on the understanding of the mechanism of molecular motors and be used to address a variety of questions pertaining to their rate, processivity, step size, efficiency, stoichiometry, etc.

We acknowledge that in the choice of the examples presented here, we have been biased by our own investigations and apologize to our colleagues for perhaps not giving proper exposure to their work. We believe that a comprehensive review would have been impossible at that stage.