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# Imaging Gene Expression

**Methods and Protocols**

**Second Edition**

Edited by

**Yaron Shav-Tal**

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## Dedication

In memory of my beloved student,

*Noa Neufeld*



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## **Preface**

Gene expression can be a term of many meanings, depending on the type of research field one belongs to. The activity of genes has been measured since the days when radioactive labeling of nucleic acids became possible and ever since the field has been ploughed through by scores of biochemical and molecular analyses, and as of recent, bioinformatics and genomics approaches. Imaging of gene expression, the topic that this book deals with, has also made an impact on our understanding of the gene expression pathway, particularly since the field uniquely deals with gene activity within single cells rather than taking a population view like the abovementioned techniques. As imaging technologies and approaches have evolved, the scope of certain imaging techniques has moved far beyond the production of purely illustrative images or appealing time-lapse movies to provide the scientist with a rich range of ways to measure and quantify the biological process and outcome of the gene expression pathway. Close interactions between biologists and physicists trying to better understand the mechanistics of gene activity have allowed the import of techniques and terminology once solely used in physics, thereby bringing to light the emerging field of biophysics.

This book aims to offer up-to-date microscopy approaches and protocols that scientists in the field have developed, which would benefit the broader scientific community. The methods not only describe the technical design of the experiments but also focus on the expected outcome and provide tips and personal insights for the benefit of the user, which we all know can sometimes tip the outcome between failure and success of a technique. This volume is divided into two parts. The first section deals with the output of a gene, namely, the RNA molecules that are transcribed from the gene and the way by which these molecules can be tracked or quantified in fixed or living cells as well as in organisms. The second section provides protocols that focus on chromosomes, chromatin, and factors that bind DNA. The methods detailed in this book portray a variety of ways by which nuclear processes intertwined with gene expression can be followed and quantified in living cells using various microscopy techniques, as well as approaches for studying several subnuclear structures found in eukaryotic cells. The chapters have been contributed by both well-established and young scientists, and I am ever grateful to all the authors who have participated and invested time, thought, and energy in the bringing of this collection to light.

*Ramat Gan, Israel*

*Yaron Shav-Tal*

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# Contents

<i>Dedication</i> .....	<i>v</i>
<i>Preface</i> .....	<i>vii</i>
<i>Contributors</i> .....	<i>xi</i>

## PART I IMAGING RNAs AND GENE EXPRESSION IN CELLS AND ORGANISMS

1 Imaging Single mRNA Molecules in Mammalian Cells Using an Optimized MS2-MCP System .....	3
<i>Maria Vera, Evelina Tutucci, and Robert H. Singer</i>	
2 Live-Cell Imaging of Long Noncoding RNAs Using Molecular Beacons.....	21
<i>Yachen Ying, Shiqi Mao, Christopher J. Krueger, and Antony K. Chen</i>	
3 Real-Time Observation of Localization and Expression (ROLEX) System for Live Imaging of the Transcriptional Activity and Nuclear Position of a Specific Endogenous Gene.....	35
<i>Hiroshi Ochiai</i>	
4 Visualization of Single mRNAs in Live Neurons .....	47
<i>Jae Youn Shim, Byung Hun Lee, and Hye Yoon Park</i>	
5 Lighting Up Gene Activation in Living <i>Drosophila</i> Embryos .....	63
<i>Carola Fernandez and Mounia Lagha</i>	
6 Quantification of mRNA Turnover in Living Cells: A Pipeline for TREAT Data Analysis .....	75
<i>Franka Voigt, Jan Eglinger, and Jeffrey A. Chao</i>	
7 Imaging rRNA Methylation in Bacteria by MR-FISH .....	89
<i>Kristina A. Ganzinger, Martin R. Challand, James Spencer, David Klenerman, and Rohan T. Ranasinghe</i>	
8 Detection of mRNA Transfer Between Mammalian Cells in Coculture by Single-Molecule Fluorescent In Situ Hybridization (smFISH).....	109
<i>Gal Haimovich and Jeffrey E. Gerst</i>	
9 Live-Cell Imaging of mRNP–NPC Interactions in Budding Yeast.....	131
<i>Azra Lari, Farzin Farzam, Pierre Bensidoun, Marlene Oeffinger, Daniel Zenklusen, David Grunwald, and Ben Montpetit</i>	
10 Detection of mRNAs Anchored to the Nuclear Envelope During Export Inhibition in Living Cells .....	151
<i>Rakefet Ben-Yishay and Yaron Shav-Tal</i>	

## PART II IMAGING CHROMOSOMES, GENES, AND TRANSCRIPTION FACTORS

11 Programmable Chromosome Painting with Oligopaints .....	167
<i>Son C. Nguyen and Eric F. Joyce</i>	

12 Imaging Chromosome Territory and Gene Loci Positions  
in Cells Grown on Soft Matrices ..... 181  
*Roopali Pradhan and Kundan Sengupta*

13 Targeted Manipulation/Repositioning of Subcellular  
Structures and Molecules ..... 199  
*Kathrin S. Heinz and M. Cristina Cardoso*

14 Visualization of Endogenous Transcription Factors in Single  
Cells Using an Antibody Electroporation-Based Imaging Approach..... 209  
*Sascha Conic, Dominique Desplanq, Alexia Ferrand, Nacho Molina,  
Etienne Weiss, and László Tora*

15 Monitoring Transcription Factor Oligomerization in Single Living  
Cells by Number and Brightness Analysis ..... 223  
*Eugenia Cammarota and Davide Mazza*

16 Visualizing Transcription Factor Binding on Mitotic Chromosomes  
Using Single-Molecule Live-Cell Imaging ..... 239  
*James Z. J. Kwan, Thomas F. Nguyen, and Sheila S. Teves*

17 Light-Induced Transcription Activation for Time-Lapse  
Microscopy Experiments in Living Cells ..... 251  
*Jorge Trojanowski, Anne Rademacher, Fabian Erdel, and Karsten Rippe*

*Index* ..... 271



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