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Methods in Molecular Biology 1297: RNA Nanotechnology and Therapeutics: Methods and Protocols

Edited by *Peixuan Guo* and *Farzin Haque*

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RNA has long been recognized as a privileged player in biology, as being the only biopolymer that has the ability to serve as a repository of genetic information, an architectural building block, and a catalyst for chemical reactions. The diversity of RNA biological functions relies on complex architectures that fold from single strands into a hierarchical sequence of secondary and tertiary structures, which rely predominantly on base-pair formation through hydrogen bonding between nucleobases. These unique and versatile properties have inspired scientists to use RNA as a building material for nanotechnology applications. Reflecting the multitude of roles that RNA plays in biology, nanotechnology research has exploited this nucleic acid for a wide range of uses, from self-assembling materials, via scaffolds for protein complexes, to therapeutics. The rapid expansion of the RNA nanotechnology field is attested to by the rapid growth of pertinent publications over the last five years, and a dedicated biannual Gordon Research Conference, which convened for the first time earlier this year.

Against this background, the *Methods* volume *RNA Nanotechnology and Therapeutics*, edited by two pioneers in the field, has been published as a timely compendium that covers the breadth of the field with only a few omissions. As is customary for a volume in this series, the book by Guo and Haque is a collection of chapters written by experts who provide brief backgrounds on various pertinent topics along with detailed laboratory protocols and experimental procedures. Novices to the field of RNA nanotechnology will find the first chapter particularly useful, as it provides an introductory overview of methods for the design, preparation, purification, and characterization of RNA nanoparticles. Each thematic point is illustrated with examples and reproduced images from the recent literature. The following 15 chapters describe experimental approaches to RNA nanotechnology in six areas. A descriptive table of contents provides for straightforward navigation among the various topics and is complemented by a detailed keyword index that allows quick identification of standard techniques, reagents, and concepts.

Three chapters each are focused on controlled, multistep assembly of RNA nanoparticles, their purification and biochemical as well as biophysical analysis. The important therapeutic aspect of RNA nanoarchitectures is covered in six chapters that outline conjugation, in vivo delivery, tissue-specific targeting, and in vivo detection. Several of the contributions on in vivo techniques focus on one particular RNA building block, the pRNA component of the bacteriophage DNA packaging motor; this is not necessarily a shortcoming because the individual authors are careful to emphasize generalizable principles that apply to nanoparticles assembled from other RNA motifs. As many therapeutic and diagnostic systems involving RNA nanotechnology will ultimately aim at in vivo applications, the collection of detailed laboratory protocols for the execution and analysis of in vivo experiments is a particularly useful aspect of this book. Among three chapters that describe approaches involving RNA–protein complexes, only one explicitly deals with the design and characterization of RNA–protein nanostructures. This particular chapter is well crafted by a pioneer in the field and captures the most salient aspects of RNA–protein nanostructures. The other two contributions describe high-throughput mapping methods applied to viral RNA–protein complexes that could become relevant approaches for nanotechnology, but whose connection to the overarching theme of the book is currently tenuous.

The target readership for this *Methods* book includes practitioners already involved in RNA nanotechnology and scientists who are considering starting research in this area. As a collection of detailed laboratory protocols, the introductory description of context and background in each chapter is expectedly terse and might not supply sufficiently broad information for the student or postdoctoral scientist who desires to learn about basic concepts in RNA nanotechnology. Although such novice readers might want to consult the more voluminous book with an identical title by the same authors (CRC Press, 2013), which provides a broader perspective on the theoretical background behind the field of RNA nanotechnology, the active experimentalist will find the new *Methods* book an ideal laboratory companion as a source of useful protocols, troubleshooting assistance, and, not least, inspiration for new experiments.

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