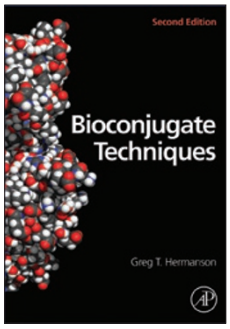
Updating the bioconjugation catalog



Bioconjugate Techniques, 2nd edition

By Greg T Hermanson

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Reviewed by Matthew B Francis

For over a century researchers have been using chemical reactions to attach synthetic functional groups to proteins and other biomolecules. Though these strategies have long been used to elucidate enzymatic mechanisms, track proteins in living cells and prepare supports for affinity chromatography, recent years have seen a dramatic expansion in the range of biomolecule-based materials and the suite of techniques that can be used to prepare them. With the availability of so many reactive strategies, there is a strong need for comprehensive guides that survey the methods and provide the chemical insight that is needed for reaction troubleshooting. The first edition of *Bioconjugate Techniques* (published in 1996) has stood as my lab's go-to guide for understanding protein reactivity, and I am delighted to find that the new second edition lives up to the high standards of practicality and chemical accuracy that were established by its predecessor.

The first section of the book begins with a thorough introduction to the reactive properties of proteins, nucleic acids and carbohydrates and provides an extensive set of reagents that have been developed to modify them. This section is generally organized by functional group type (for example, thiol reactions), and it provides reaction protocols for many of the available coupling strategies. Topics added since the first edition include native chemical ligations, click chemistry, the Staudinger ligation and several new photochemical reactions. The book generally does not discuss enzymatic ligation reactions, but instead maintains its focus on synthetic chemistry techniques. Each strategy is accompanied by accurate and well-drawn chemical schemes that explain the chemistry and the nature of the reaction products. These sections of the book provide the most detailed discussion of bioconjugation reactions that I know of, and they can serve as both a laboratory reference guide and an essential read for anyone interested in developing future strategies.

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The second section provides an introduction to the rapidly expanding collection of synthetic groups that are now available for biomolecule attachment. Each component is introduced with a brief discussion of its key physical and reactive properties. Chapters covering crosslinkers and fluorescent probes have been expanded significantly since the previous edition, and now include discussions of quantum dots and luminescent lanthanide complexes. A new section on dendrimers has been added that describes several compositional types and the methods that can be used to activate their surfaces for further functionalization. New methods for the attachment of biomolecules to polymers, carbon nanotubes and fullerenes are discussed, as are common techniques for biotinylation and iodination. Although they are not covered in the same chapters, techniques are also discussed for the attachment of biomolecules to silica and gold surfaces. Finally, a section covering selectively cleavable linkers has also been included. These are particularly useful as a part of affinity purification strategies or as components of drug delivery systems that can release attached cargo after cellular uptake has occurred.

After introducing the reactions and the basic components, the final section of the book demonstrates the use of bioconjugates in a number of practical contexts. Although it is not possible to provide a complete discussion of each subject that is introduced, the author provides essential background information on topics such as liposomes and gold nanoparticles and describes several applications for which their bioconjugates have been used. This section also contains two chapters describing antibody modification, including experimental procedures. The book concludes with a series of techniques that have been used to study protein-protein interactions.

A particular strength of this book is the inclusion of representative experimental protocols throughout. As examples, detailed procedures are given for the conjugation of antibodies to toxins, the activation of liposome surfaces for protein attachment, the preparation of hapten-carrier conjugates and the installation of PEG polymers on protein surfaces. My lab has used a number of protocols from the first edition successfully, and I expect that the expanded set available in the second edition will be equally reliable. One drawback is that it is not always clear which reference is the source for an experimental protocol, which can make it more difficult to troubleshoot a reaction that does not go as planned. However, the addition of these procedures to the book makes it much easier to determine whether a technique is likely to be compatible with the stability and solubility requirements of a particular biomolecular target.

In my opinion, this is the best book available that describes bioconjugation reactions, in terms of both its comprehensive coverage and its chemical accuracy. It is a 'must have' for any lab that routinely prepares modified proteins or oligonucleotides, and it can serve as a great starting point for learning about the many new components that have been used to study or enhance biomolecular function. Those who own the first edition will find that the tried-and-true reagents still appear throughout, but the many new reactions and applications described in this expanded edition make it a worthwhile update.