
Preface

Biomolecules in nature exhibit overwhelming one-handedness, often called homochirality, such as L-amino acids and D-sugars. Since the discovery of molecular chirality by Pasteur, the origins of chirality and the process leading to enantiopure biomolecules have attracted broad attention from many researchers. Several theories have been proposed for the origin of chirality in organic compounds, for example, left and right-circularly polarized light, spontaneous absolute asymmetric synthesis, and chiral inorganic crystals such as quartz. However, the enantioenrichments induced by these mechanisms have been very low or even below detection levels. Thus, the process of amplification of enantioenrichment is inevitable to reach enantiopure compounds. In 1953, Frank proposed a mechanism of asymmetric autocatalysis without mentioning any chemical structure. However, it then took over 40 years for us to discover asymmetric autocatalysis with amplification of chirality in 1995.

This book illustrates the recent aspects of amplification of chirality by asymmetric autocatalysis and by forming helical structures. The first four chapters summarize experimental asymmetric autocatalysis with amplification of enantiopurity, the mechanism of asymmetric autocatalysis examined by NMR and calculation, the computer simulation models of the reaction mechanism of asymmetric autocatalysis, and the theoretical models of amplification of chirality. The last chapter deals with the amplification of chirality by the formation of helical structures. However, the amplification of enantiopurity in non-autocatalytic asymmetric reaction and the amplification by enantiomer separation involving crystallization or sublimation are beyond the scope of this book.

One of the main features of asymmetric autocatalysis and the formation of the helix is that the initial extremely low enantioenrichment is amplified significantly to near enantiopure. These processes of amplification of chirality have become powerful tools to elucidate the origin of chirality of organic compounds. For example, by using asymmetric autocatalysis, spontaneous absolute asymmetric synthesis without the intervention of any chiral factor has been realized.

Amplification of Chirality

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2008, XI, 205 p., Hardcover

ISBN: 978-3-540-77868-4