

Synthesis of Organic Materials: It's Techniques and Applications

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DESCRIPTION

Organic synthesis is a subset of chemical synthesis that deals with the deliberate construction of organic compounds, because organic molecules are frequently more complex than inorganic compounds, their synthesis has evolved into one of the most important branches of organic chemistry. Within the broad field of organic synthesis, there are three major research areas: total synthesis, semi synthesis, and methodology. The complete chemical synthesis of complex organic molecules from simple, commercially available petrochemical or natural precursors is referred to as a total synthesis. Total synthesis can be accomplished in two ways: linearly or convergent. A linear synthesis, which is often adequate for simple structures, involves performing several steps one after the other until the molecule is complete; the chemical compounds formed in each step are referred to as synthetic intermediates. Each step in a synthesis usually refers to a separate reaction that occurs to modify the starting compound. For more complex molecules, a convergent synthetic approach, which involves the individual preparation of several "pieces" (key intermediates), which are then combined to form a product that may be preferable. When compared to linear synthesis, convergent synthesis produces a higher yield.

Robert Burns Woodward is regarded as the father of modern organic synthesis, having received the Nobel Prize in Chemistry in 1965 for several total syntheses (for example, his 1954 synthesis of strychnine. Each step of a synthesis involves a chemical reaction, and the reagents and conditions for each of these reactions must be designed to produce an adequate yield of pure product while requiring the fewest steps possible. A method for making one of the early synthetic intermediates may already exist in the literature, and this method will usually be used rather than attempting to "reinvent the wheel." Most intermediates, on the other hand, are compounds that have never been made before, and they are typically created using general methods developed by methodology researchers. To be useful, these methods must produce high yields and be consistent across a wide range of substrates. Additional barriers for practical applications include industrial safety and purity standards.

Methodology research typically consists of three major stages; discovery, optimization, and scope and limitation studies. The discovery necessitates a thorough understanding of and experience with the chemical reactivity's of appropriate reagents. Optimization is the process of testing one or two starting compounds in a reaction under a wide range of conditions such as temperature, solvent, reaction time, and so on, until the optimal conditions for product yield and purity are discovered. Finally, the researcher tries to apply the method to a variety of different starting materials in order to determine its scope and limitations. Total syntheses (as mentioned above) are sometimes used to showcase new methodologies and demonstrate their utility in real-world applications. These applications involve major industries, particularly polymers (and plastics).

The bioactivity of chiral molecules varies with the enantiomer in most complex natural products. Historically, total synthesis sought racemic mixtures, or mixtures of both possible enantiomers, which could then be separated *via* chiral resolution. Chemists began to develop methods of stereo selective catalysis and kinetic resolution in the latter half of the twentieth century, allowing reactions to be directed to produce only one enantiomer rather than a racemic mixture. Early examples include stereo selective hydrogenations (e.g., as reported by William Knowles and Ryji Noyori) and functional group modifications such as Barry Sharpless's asymmetric epoxidation; these workers were awarded the Nobel Prize in Chemistry in 2001 for these specific achievements. Previously, only natural starting materials could be used in such reactions, giving chemists a much broader range of enantiomerically pure molecules to work with. Chemists became more capable of taking simple molecules through to more complex molecules without unwanted racemisation by understanding stereo control, allowing final target molecules to be synthesised as pure enantiomers, thanks to techniques pioneered by Robert B. Woodward and new developments in synthetic methodology. Stereo selective synthesis is the name given to such techniques.

Elias James Corey was awarded the Nobel Prize in Chemistry in 1990 for developing a more formal approach to synthesis design based on retrosynthetic analysis. The synthesis is planned backwards from the product using standard rules in this approach. The steps for "breaking down" the parent structure into achievable component parts are depicted graphically using retrosynthetic arrows (drawn as, which mean "is made from"). Computer programmes for designing synthesis based on sequences of generic "half-reactions" have been written more recently and are less widely accepted.