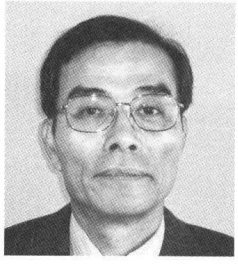
The Role of Organic Synthesis in Nanotechnological Science



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In the last century, more remarkable progress in science and technology has been made. Now, the world is stepping into a completely new and unexplored era. 'Environment' and 'innovation' are the most important key words, which are closely related to 'Organic Synthesis'. We need further efforts to develop science and technology from the viewpoint of environmental sustainability in order to maintain a comfortable lifestyle. The word 'Innovation' is derived from the Latin, 'innovare' (renew) ['in' (within) + 'novare' (change)]. Ideas, scientific discoveries, and invention alone are not innovation. Scientific knowledge needs to be developed to *meet the needs of* economic and social benefits. To achieve the innovation, nanotechnology is so important that a committee for the study of national nanotechnology initiatives has been operating within the Ministry of Economy, Trade and Industry. In nanotechnology, two main approaches are used: in the bottom-up approach, materials and devices are built from molecular components which assemble themselves by principles of molecular recognition; and in the "top-down" approach, nano-objects are constructed from larger entities without atomic-level control. The chemistry that is researched from atomic and molecular levels can contribute mainly to the former approach. We can say that synthetic chemistry has reached the point where it is possible to prepare small molecules to almost any structure. The ability of organic synthesis to prepare any kind of organic molecules raises the next challenge of seeking methods to assemble these single molecules in supramolecular assemblies consisting of many molecules arranged in a well-defined manner. These approaches utilize the concepts of molecular self-assembly and/or supramolecular chemistry to automatically arrange themselves into some useful conformation through a bottom-up approach. However, the supramolecules are not always advantageous because they are constructed via weak non-covalent bonds. It is likely that their practical use is occasionally limited due to the weak bonds. Recently, the supramolecules that are first of all formed by hydrogen bonds (>B-OH···O(H)-R) were reported to be thermally converted to 3D organic frameworks with large cavity, which involve only the covalent bonds (>B-O-R) (*Science*, **2007**, *316*, 268). This seems to present one of the strategies that make the supramolecular chemistry meet its practical needs.

The main research fields in organic synthesis are (i) the establishment of a synthetic route leading efficiently to a target molecule and (ii) the development of a new reaction for synthesizing an organic molecule. At the present time, we can synthesize relatively simple molecules once they are designed, but their range does not seem to be beyond that of our knowledge. It should be emphasized that the invention of a new reaction would lead to the creation of entirely new organic molecules. Hence, organic synthesis can be regarded as the treasure house of new materials with unprecedented functional properties. Surely, this is the so-called serendipity. Thus, 'organic synthesis' will play an important role in the research of nanotechnological science.