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Olefin Metathesis and Related Reactions in the Synthesis of New Polymeric Materials

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Olefin metathesis is a relatively new chemical reaction, the first information of which appeared in the 1950s. Since then, owing to its unique synthetic capabilities, it has become the focus of attention of hundreds of research chemists in different countries. Numerous unsaturated compounds were involved in the reaction, and hundreds of catalytic systems based on metals with variable valence have been proposed. The result was a technology for synthesizing a variety of valuable materials, often unparalleled in their physicochemical characteristics. Olefin metathesis formed the basis for industrial synthesis of a number of widely used monomers (ethylene, propylene, 2-butene) and polymers, such as polynorbornene (trademark Norsorex), polydicyclopentadiene (Telene, Metton, Pentam, and Proxima), and polyoctentamer (Vestenamer). It has been used to obtain a number of biologically active substances: insect pheromones and drugs. In other words, the range of metathesis is extremely wide. A special scope of its study was obtained after the so-called "well-defined" catalysts based on molybdenum and ruthenium compounds were discovered by R. Schrock and R. Grubbs.

In Russia, different olefin metathesis variants are currently being studied at the Topchiev Institute of Petrochemical Synthesis, Russian Academy of Sciences; the Nesmeyanov Institute of Organoelement Compounds, Russian Academy of Sciences; the Razuvaev Institute of Organometallic Chemistry, Russian Academy of Sciences (Nizhny Novgorod); Tomsk Polytechnic University; Irkutsk State University; and OOO Joint Research and Development Center.

The studies with the most long-standing and successful tradition are at in the Topchiev Institute of Petrochemical Synthesis, Russian Academy of Sciences, where the first publications related to metathesis began to be published in the late 1960s–early 1970s. Since then, a number of laboratories have undertaken research that have contributed significantly to the establishment of the chain carbene metathesis mechanism, development of methods for the polymerization of cyclopentene and a number of other cycloolefins, and methods for the destruction and further processing of unsaturated polymers. Possibilities have been discovered for the metathesis of silicon-containing olefins, efficient synthesis of energy-intensive hydrocarbons and insect pheromones, and production of silicon-containing polynorbornenes, which have the properties of efficient gas-permeable membranes.

This issue of the journal presents the works of the aforementioned Russian research centers, as well as articles with the participation of employees of universities and research institutes in Germany, the United Kingdom, Austria, and China.

These publications reflect the results of the gas-permeable membrane synthesis by ring-opening metathesis and testing thereof, preparation of new active dicyclopentadiene polymerization catalysts, metathesis in ionic liquids, polymerization of tricyclononenes and polysubstituted norbornenes, and macromolecular cross-metathesis between unsaturated polymer chains. These studies expand the synthetic possibilities of the olefin metathesis reaction and indicate promising directions in this field of catalytic chemistry.

E. Sh. Finkelshtein and M. L. Gringolts