

Fifty Years of the Boreskov Institute of Catalysis

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Boreskov Institute of Catalysis, Siberian Branch, Russian Academy of Sciences, celebrates 50 years of existence this year. The Institute of Catalysis is the largest institution of the Russian Academy of Sciences in chemistry. The prudent original conception of the Institute's activities, which was based on combining fundamental research with solving challenging problems of industry, has helped the Institute to become one of the world's most prominent research centers in chemical catalysis. Many of the Institute's R&D results are among the most important achievements of catalysis science.

The Institute performs fundamental and applied studies aimed at creating new high-efficiency and high-selectivity catalysts and catalytic systems. The priority research areas of the Institute are the following:

- chemical catalysis as a phenomenon and prediction of catalytic activity;

- theory and scientific bases of catalyst preparation;

- kinetics of catalytic processes and theoretical foundations of chemical engineering;

- catalysts and catalytic processes for new applications;

- principles of the deliberate synthesis of complex organic and inorganic compounds.

Basic research is carried out in the following areas:

- catalysis at the atomic/molecular level;

- nature of the active sites of catalysts and mechanisms of key catalytic reactions;

- catalyst structure and formation mechanisms;

- kinetics and simulation of catalytic processes.

The successful development of the Institute has been possible only due to the existence of scientific schools headed by the Institute's leading scientists in a variety of important research areas.

Academician G.K. Boreskov: heterogeneous catalysis theory, the nature of the interaction between the reactants and the catalyst, the effect of the reactant–catalyst bond energies on the catalytic activity and selectivity, concepts of stepwise and associative mechanisms of redox catalytic reactions, unsteady-state catalysis, and development of industrial catalysts.

Academician K.I. Zamaraev: theory of electron tunneling in solids, the coordination chemistry of metal complex solutions, stepwise mechanisms of homogeneous and heterogeneous catalytic reactions, active site

structure at the atomic/molecular level, and search for novel areas in catalysis.

Academician V.N. Parmon: catalysis and photocatalysis in renewable and non-traditional energetics, photochemical and thermochemical methods of solar energy conversion, radiation-induced thermal catalysis, the role of photocatalysis in the global chemistry of the terrestrial atmosphere, abiogenic catalysis in nature, synthesis of nanomaterials, and new types of chemical reactors.

M.G. Slin'ko, Corresponding Member of the Russian Academy of Sciences: simulation of catalytic processes and reactors based on hierarchical models; optimization and modeling of processes in fixed and fluidized beds; simulation of liquid-phase, multiphase, and unsteady-state processes; design of industrial reactors.

R.A. Buyanov, Corresponding Member of the Russian Academy of Sciences: scientific basis of catalyst preparation, enhancing the reactivity of solid phases, mechanochemistry in catalysis, catalyst deactivation, theoretical basis of the synthesis of carbon–mineral composites, the theory of nonbranched-chain free-radical catalytic reactions, and development of industrial catalysts.

V.A. Likholobov, Corresponding Member of the Russian Academy of Sciences: molecular design of catalytic compositions for organic syntheses, “assemblage” of the active sites of metal complex catalysts, and synthesis of porous supports with the desired texture and surface properties.

Professor Yu.I. Ermakov: targeted synthesis of supported catalysts with the desired composition and dispersion using immobilized organometallic compounds, catalytic polymerization of olefins, development of industrial catalysts.

Professor V.A. Dzis'ko: formation of oxide catalysts of complex composition; control of the chemical and phase compositions, acid–base surface properties, textural and strength characteristics, and heat resistance of catalysts; development of industrial catalysts and supports.

Professor G.M. Zhidomirov: heterogeneous catalysis theory; principles of the IR spectroscopy of the surface; quantum chemical modeling of catalytic systems; calculation of the electronic structure and properties of the acid and redox sites of zeolite, oxide, and metal catalysts.

At present, the Institute has over 1000 employees, including 400 researchers, among which there are more than 60 doctors of sciences and over 200 candidates of sciences. The Institute has eight research departments, a department of exploratory and applied studies, an applied catalysis department, and an information center. The Institute is a unique association of specialists in various fields of science and technology that are capable of solving any problem of catalysis. The scope of the Institute's activities is extremely wide, ranging from solving fundamental problems of catalysis to creating new catalytic technologies and organizing commercial-scale production of catalysts.

The high level of the fundamental research carried out by the Institute is reflected by numerous monographs, as well as articles published in prestigious international journals and collections of works. The Institute publishes more than 300 works per year in peer-reviewed journals. According to the interdisciplinary server www.scientific.ru, the Institute has the highest total citation index among the Russian chemical institutions over the last 7 years. The average citation index of one article is above 6 and is high on the citation index list of articles from chemical institutions of the Siberian Branch of the Russian Academy of Sciences.

The Institute patents over 40 discoveries and maintains more than 30 foreign patents annually. In the last 5 years, it has received 180 patents in Russia. The Institute is the avowed intellectual property protection leader among the Russian academic institutions.

The Institute is known as the center that has accumulated the progress of the entire chemical science in Novosibirsk region. In collaboration with other institutions and companies, it regularly organizes international conferences, workshops, school sessions, presentations, and various working meetings. In the last five years alone, the Institute has organized more than 60 diverse conferences and seminars.

The Institute collaborates very efficiently with the global catalytic community, using a wide variety of forms of cooperation. The Institute's researchers are engaged in many international projects and programs, working at many international centers in Europe, America, and Asia. The joint laboratories between the Institute and the European, American, and Asian centers, working on a continuing basis, carry out studies in power engineering, environmental protection, fine organic synthesis, and particularly the properties of catalysts and adsorbents.

The Institute is designing new generations of catalysts and technologies to meet the present-day global trends. Throughout its 50-year-long history, the Institute has been among the leaders in developing new technologies for the chemical and petrochemical industries, power engineering, and environmental protection. The numerous exploratory and prospective studies of the Institute in the field of catalytic technologies include advancement of a large complex of environ-

mental and energy-saving technologies, use of non-traditional feedstocks in the production of various motor fuels and oil processing products, fine synthesis of medicines and plant protection chemicals, etc.

The Institute, today the largest academic institution in the field of catalysis, is widely known abroad for its achievements and is a partner of many Russian and foreign companies. The Institute has created over 70 catalysts and catalytic technologies, which are now employed in the leading branches of industry. It has designed original devices for studying the properties of catalysts and has organized small-scale production of automated devices and installations for investigation and control of the physicochemical properties of various substances and materials. The novel, high-efficiency catalysts and technologies developed by the Institute satisfy the present-day requirements and are in demand in Russian markets and around the world. The Institute's applied studies addressing challenging practical problems are performed within the most important governmental programs.

The highest priorities of the personnel policy of the Institute are support for those just starting and enhancement of the potential of the personnel. Deeply convinced that taking care of the human factor is the key to success and that the best way of learning is by educating others, the scientists of the Institute take active part in the training of young specialists. Every year, the Institute provides practical and research training for over 150 students and postgraduates from more than ten departments of various universities, primarily Novosibirsk State University and Novosibirsk State Technical University.

In the 20th century, demand for specialists in catalysis grew very rapidly. At present, they are needed in various spheres of human activity, including not only science and industry, but also agriculture and medicine. The interaction of chemistry with physics, biology, geology, and mathematics has extended the scope of catalysis and has given birth to new, promising research areas. The 50-year-long history of the Institute is a glowing example of fruitful interaction between fundamental science and industry and of the profound realization that solving scientific problems should be aimed at some practical result. The accomplishments of the Institute embody its original conception, which includes studies at the atomic/molecular level and commercialization of the results. It is due to this approach that the Institute has made a significant contribution to the material and technical basis necessary for the rapid development of the Russian chemical industry.

*Academician V.N. Parmon, Director
of the Institute of Catalysis, Siberian Branch,
Russian Academy of Sciences*