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Department of Chemistry of the M V Lomonosov Moscow State University



This issue of the Journal is devoted to the 250th anniversary of the M V Lomonosov Moscow State University (MSU), an outstanding event in the history of culture, education and science in Russia. From the very moment of the foundation of Moscow University, studies into various chemical processes and training of students in fundamental chemistry formed a significant part of its educational and research activities. The interest in specific characteristics of substances and their possible interconversions initiated by M V Lomonosov is being realised in the wide-ranging research activities which encompass virtually all areas of modern chemistry. At the beginning, chemical investigations were carried out by the Department of Physics and Mathematics up to the establishment, in 1929, of the Department of Chemistry as an independent structural division of Moscow University.

The structure of the Department of Chemistry developed over decades reflects the evolution of scientific ideas, scientific schools and priorities characteristic of chemical education and science at different stages of its development.

Traditionally, the divisions and laboratories of the Department were grouped around physicochemical, organic and inorganic cycles. The advent and explosive development of a science of macromolecules and polymeric materials resulted in the establishment of a Division of Polymer Science, while the growing interest of chemists in processes occurring in living matter gave an impetus to the establishment and further development of the Divisions of Chemistry of Natural Compounds and Chemical Enzymology.

The indissoluble unity of educational and research processes is the main prerequisite for the fruitful development of the Department of Chemistry and its advancement. Today, the Department of Chemistry admits annually 215 students from various regions of Russia. During the first five semesters, the students receive fundamental chemical knowledge. In the second semester of the third year, the students are allowed to choose a division, a laboratory and a research group that interests them most. The fourth and fifth years are devoted to specialised lecture courses, practical and research work. The educational cycle is terminated by the defence of a diploma work, which usually represents an expert study in one of the most advanced fields of chemistry. A large ($\sim$100 people) contingent of graduates take a postgraduate course at the Department of Chemistry and complete their education by presentation of a Ph.D. thesis. This is actually the end of the eight-year educational cycle, which is aimed at the training of high-level specialists.

The staff members of the Department, being interested in retention of the highest level of teaching chemistry in modern higher school and attraction of the most talented and capable secondary school graduates to the Department, develop high educational standards. In large measure, this task is fulfilled through the involvement of schoolchildren in annual federal and international multilevel chemical olympiads.

The most advanced level of education and research at the Department of Chemistry of MSU is maintained owing to long-standing traditions, rich experience of research work and significant contributions by the most outstanding representatives of Russian chemical science to its development. Academicians A N Nesmeyanov, A V Novoselova, N N Semenov, N M Emanuel, V A Kargin, P A Rehbinder, A N Frumkin, V I Spitsin, I P Alimarin and the Corresponding Members I V Berezin, Ya I Gerasimov and many others have worked at the Department of Chemistry of MSU at different times. At present, the divisions of the Department are headed by Academicians V A Kabanov (Division of Polymer Science), N S Zefirov (Division of Organic

Chemistry), V V Lunin (Division of Physical Chemistry), Yu D Tretyakov (Division of Inorganic Chemistry), Yu A Zolotov (Division of Analytical Chemistry), A A Bogdanov (Division of Chemistry of Natural Compounds), A L Buchachenko (Division of Chemical Kinetics) as well as by Professors S D Varfolomeev (Division of Chemical Enzymology), O A Petrii (Division of Electrochemistry), B D Summ (Division of Colloidal Chemistry), S F Dunaev (Division of General Chemistry), E A Karakhanov (Division of Petrochemistry and Organic Catalysis), V M Fedoseev (Division of Radiochemistry), V V Avdeev (Division of Chemical Technology and Novel Materials), Yu A Kuzyakov (Division of Laser Chemistry). Each of the Department's divisions is an independent research-and-educational centre which specialises in a particular branch of modern chemical science.

Academicians N A Plate, I P Beletskaya, N F Bakeev and the Corresponding Members of RAS A B Zezin, A L Volynsky and I V Melikhov are working successfully at the Department of Chemistry of MSU. The Department is one of the leading multidisciplinary research-and-educational establishments in Russia. Over 1000 teachers and researchers are working in the Department. Every year, staff members of the Department of Chemistry publish 1100 scientific papers and participate in 15–20 congresses, conferences and symposia. About 150 Ph.D. and D.Sci. theses are defended at specialised councils of the Higher Attestment Commission.

As regards the quality of research and citation rates of published papers, the highly fruitful research-and-education activities in the Department of Chemistry account for its high prestige both inside the country and abroad.

This issue of the Journal 'Russian Chemical Reviews' comprises reviews reflecting the scientific interests of different research groups working at the Department of Chemistry of MSU.

The review by Academician V A Kabanov 'Polyelectrolyte complexes in solution and in bulk' considers various reactions between oppositely charged polymeric molecules in aqueous solutions which result in the formation of insoluble (stoichiometric) and soluble (non-stoichiometric) interpolyelectrolyte complexes. Thermodynamics, kinetics and mechanisms of reactions of charged polyelectrolytes and the formation of interpolymeric complexes, which represent a special family of polymeric materials, are considered. Some unusual phenomena are described. Thus soluble non-stoichiometric polymeric complexes manifest properties of linear polyelectrolytes, but often behave as amphiphilic block copolymers. The nature of the forces controlling the behaviour of the complexes and properties of multilayer materials obtained by alternation of polycations and polyanions are discussed.

The review by Dr. A A Galkin and Academician V V Lunin 'Subcritical and supercritical water: a universal medium for chemical reactions' is devoted to the discussion of the properties of water in the sub- and supercritical states. The unique properties of water in the aforementioned states as media for chemical reactions are demonstrated. A wide range of problems including some peculiarities of experimenting with water in its sub- and supercritical states, chemical characteristics of reactions of organic compounds in these media, synthesis of nanocrystalline oxides and application of sub- and supercritical water in various waste utilisation processes are discussed.

The review by Academician Yu A Zolotov *et al*. 'Sorption preconcentration of microcomponents for chemical analysis' is devoted to one of the most important trends in analytical chemistry developed by the Division over decades, *viz*., sorption preconcentration. This procedure is based on the use of various synthetic and natural sorbents and enables a significant increase in the detection limits of analytes. The use of various methodological approaches and design of hybrid and combined variants of analysis allow one to determine, with a high level of efficiency, a broad range of compounds including organic and inorganic substances.

The review by Prof. S D Varfolomeev *et al*. 'Catalytic sites of hydrolases: structures and catalytic cycles' deals with the description of the structures and functions of active sites of enzymes. A detailed analysis of modern computer databases of protein structures is given. Methods for identification of active sites of enzymes based on the analysis of computer databases are considered. The structural paradox of enzymatic catalysis, which suggests that the practically infinite variability of protein structures within the framework of a concrete catalytic task is confined to a limited number of catalytic site structures responsible for the catalytic act, is discussed for the example of a special class of enzymes, *viz*., hydrolases.

The review by Prof. T S Oretskaya *et al*. 'Covalent binding of modified nucleic acids to proteins as a method for investigation of specific protein–nucleic acid interactions' is devoted to the study of specific interactions between proteins and nucleic acids. Covalent binding of modified nucleic acids to proteins is considered as a method of investigation. Methods for the introduction of modifications in the structures of nucleic acids, synthesis of photoactive derivatives and structures of 'nucleic acid–protein' conjugates formed upon enzymatic reactions are discussed. The development of these methods allows identification of a specific site in a protein bound to a nucleic acid.

The main emphasis in the review by Prof. E A Karakhanov *et al*. 'Design of supramolecular metal complex catalytic systems for organic and petrochemical synthesis' is laid on supramolecular metal-complex systems. The formation of active sites, which involves macrocyclic receptor molecules, opens up prospects, new in principle, for the design of catalysts for hydrogenation, hydroformylation, carbonylation, hydroxylation, *etc*.

The issue includes only some of the reviews prepared by researchers of the Department of Chemistry and dedicated to the 250th anniversary of the Moscow State University. One of the next issues of the Journal will also be devoted to this jubilee event. We are sure that the reviews presented herein as well as those designed for publication in the subsequent issues of the Journal will be interesting for a broad circle of readers and will shed additional light on the main trends and level of research carried out by the Department.

Academician V V Lunin
Professor S D Varfolomeev