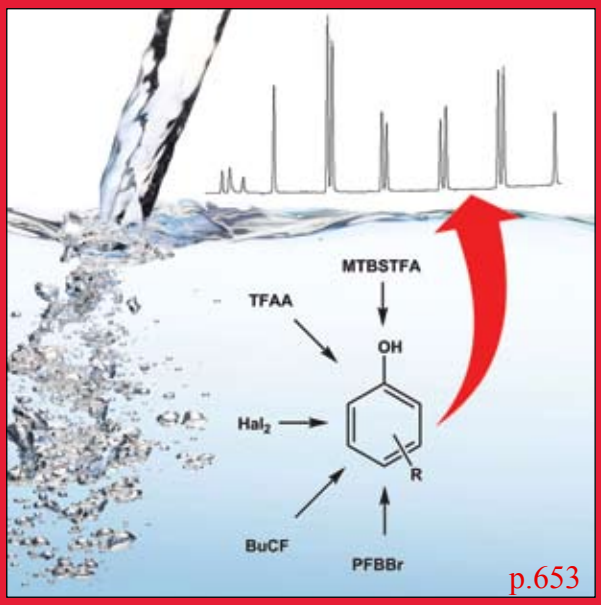
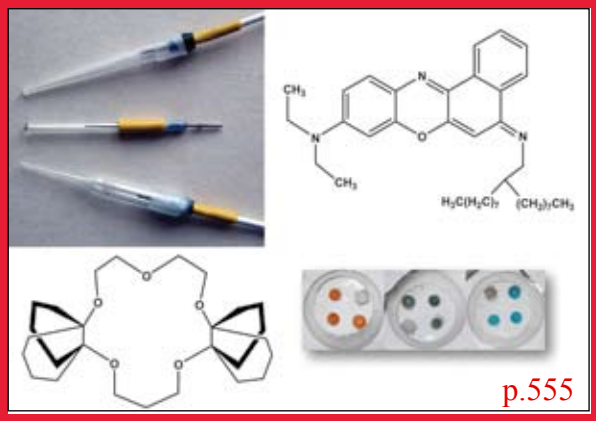
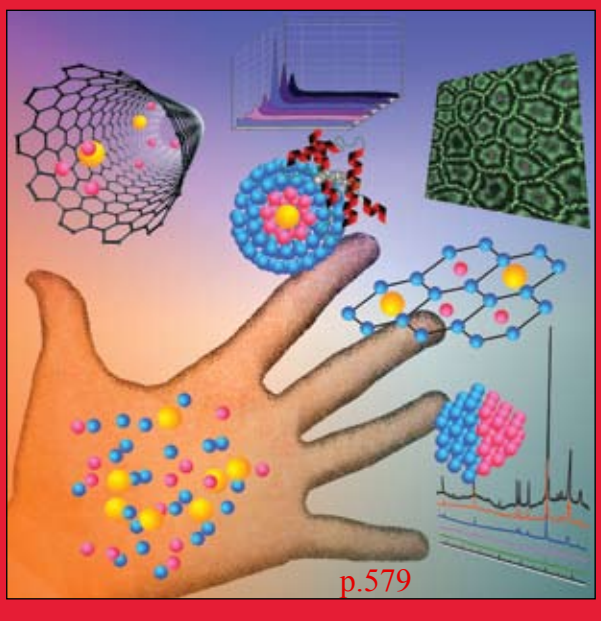
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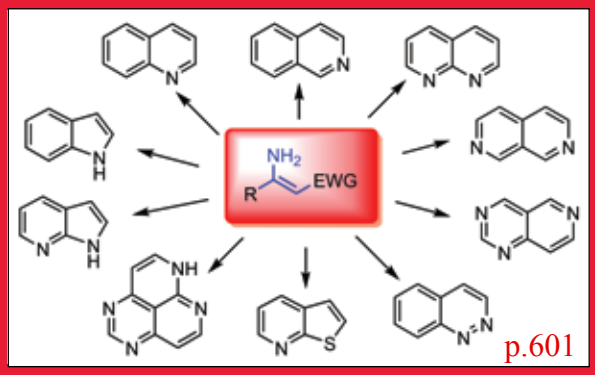
Russian Chemical Reviews



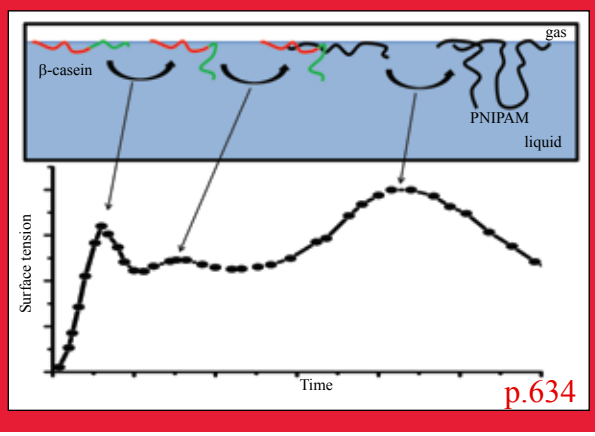
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Reviews on current topics in chemistry

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Development of chemistry at the Saint Petersburg State University — from Lomonosov to our time

Russian science as a whole started from the decree of Peter the Great of 1724 concerning the foundation of the Academy of Sciences, which was accompanied by establishment of the Academic Gymnasium and Academic University. Chemistry was among the sciences that were meant for the Academy but actually chemistry started to develop when M V Lomonosov founded a chemical laboratory, which was built not far from the Spit of Vasilievsky Island. The laboratory functioned from the late 1748 up to M V Lomonosov's death in 1757; however, this building no longer exists. Despite the fact that the Academic University stopped functioning in 1796 for the lack of students, chemistry was preserved and developed at the Petersburg Academy, although not vigorously.

The year of 1838 when A A Voskresensky, the 'grandfather of Russian chemistry', started to teach at the division of chemistry of the Faculty of Physics and Mathematics of the Petersburg University is believed to mark the true origin of systematic chemical education at the University and to be a strong impetus for the development of chemistry in Russia. At the same time, a new chemical laboratory was established and theses in chemistry were defended.

As soon as 1868, the expanded division of chemistry split into three parts, *viz*., for inorganic, organic and analytical chemistry, which were headed by D I Mendeleev, A M Butlerov and N A Menshutkin, respectively. Moreover, it is in 1868 that Russian Chemical Society was formed at the Petersburg University by initiative of scientists from the Faculty of Physics and Mathematics. In 1878, this society was transformed into Russian Physical and Chemical Society. N N Zinin was elected the first President of the Society. D I Mendeleev emphasized that the formation of Russian scientific schools started, in essence, from N N Zinin and A A Voskresensky: 'all contemporary Russian chemists have grown from Zinin, on the one hand, and Voskresensky, on the other hand'.

In the late 19th century, the school of A E Favorsky, an outstanding organic chemist of the 20th century, started to form at the Petersburg University. (A E Favorsky's key research area was acetylene chemistry; he discovered the reaction leading to tertiary acetylenic alcohols named after him). Back before the revolution of 1917, a number of well-known scientists worked under his supervision, namely, S V Lebedev and B V Byzov (who developed the industrial process for the production of synthetic rubber from buta-1,3-diene, which was in turn synthesized from ethanol by the 'Lebedev method' or by oil cracking according to Byzov), S N Danilov (who developed efficient methods for the preparation of cellulose esters, which were of great value for the synthetic fibre industry), Zh I Iotsich (whose name is associated with the preparation of alkylmagnesium halides — Iotsich reagents) and V N Ipatiev (preparation of cyclopropanes from 1,4-dibromoalkenes — Ipatiev reaction; catalysis at high temperature and pressure). During the First World War, V N Ipatiev created the coke and benzene industry in the south of Russia and after emigration to the USA, he became the 'father' of American petrochemical industrial synthesis.

Among scientists who taught students and carried out active research at the University at the end of the 19th century were N A Menshutkin (who studied amine quaternization — Menshutkin reaction; he was the first to quantitatively elucidate the solvent effect on the chemical reaction rates), V E Tishchenko (who studied disproportionation of aldehydes to give esters under the action of aluminium alkoxides — Tishchenko reaction) and D P Konovalov (who discovered the dependence of the relative contents of components in the gas and liquid phases of solutions on the vapour pressure and the boiling points of binary liquid systems — Konovalov laws).

The formation of the Russian school of coordination and organometallic chemistry, which started in the 20th century, was also associated with the Petersburg University, where L A Chugaev was invited at that time (he formulated the 'rule of rings', synthesized the first metal-containing carbenes, discovered the test reaction for nickel, performed pioneering studies of platinum chemistry). A number of classical coordination and organometallic chemists graduated from the Universty: A A Grinberg (classical works in the chemistry of platinum and other noble metals; discovery of the *cis*-effect), I I Chernyaev (discovery of the *trans*-effect in coordination compounds), G A Razuvaev (organometallic chemistry and free radical reactions), M G Voronkov (fundamental works in the field of organic chemistry of silicon and sulfur) and M M Koton (organometallic polymer chemistry).

In different periods, other prominent chemists have worked at the Faculty of Chemistry such as V G Khlopin (a founder of Soviet radiochemistry and radium industry), B P Nikolsky (developer of the ion exchange theory for glass electrodes), and M M Shultz (fundamental works on the thermodynamics of heterogeneous systems and glass chemistry and electrochemistry). Other scientists who graduated from the University are N N Semenov, a Nobel Prize winner of 1956 (in Leningrad, he discovered a new type of chemical reactions, namely, branched chain reactions, in 1927; for the theory of these reactions, he was later awarded the Nobel Prize), V I Vernadsky (founder of the biogeochemistry), I V Grebenshchikov (the author of the chemical theory of glass finishing and glazing and blooming of optics), A A Baikov (founder of the Russian school of metal science and metallurgy), A N Terenin (founder of the Russian school of photonics), V A Fock (classical works in the field of atomic structure and chemical bond, Hartree – Fock theory).

The Faculty of Chemistry of the Saint Petersburg State University (SPbSU) founded in 1929 stemmed from the division of chemistry of the Faculty of Physics and Mathematics of the Imperial Saint Petersburg University. From 1934 to 2007, Research Institute of Chemistry existed at the

University on the Basis of the Faculty of Chemistry. The Research Institute was merged with the Faculty of Chemistry (2002) to form the Education and Research Centre of Chemistry. Moving to Peterhof (1983 – 1985) started a new history of the Faculty; the strongest impetus to the development of chemistry was given in 2005 by the Law on the special status of the Saint Petersburg State University and M V Lomonosov Moscow State University as 'unique scientific and educational complexes, the oldest higher educational institutions of Russia, being of great importance for the development of the Russian society', which implied the appropriate support including funding at the level of the Russian Federation Government. The subsequent rearrangements aimed at increasing the level of scientific and educational activity of the SPbSU affected all of the University departments including chemists.

Currently, the Institute of Chemistry of the SPbSU (headed by I A Balova) comprises 14 departments (analytical chemistry, quantum chemistry, colloid chemistry, laser chemistry and laser material science, general and inorganic chemistry, organic chemistry, radiochemistry, physical chemistry, physical organic chemistry, high-molecular compounds chemistry, natural compounds chemistry, solid state chemistry, chemical thermodynamics and kinetics and electrochemistry), the laboratory of cluster catalysis (headed by Corresponding Member of the RAS V P Ananikov) and the laboratory of biomedical chemistry (headed by T B Tennikova). Academician A I Rusanov and Corresponding Members of the RAS N A Smirnova, V L Stolyarova and V Yu Kukushkin work at the Institute.

Some results of the chemical research performed at the Saint Petersburg University were presented at the '16th Mendeleev Congress on General and Applied Chemistry', which was held in St Petersburg in 1998, being timed to the 250th year anniversary of the Russian chemical science. Of special note are the activity of the St Petersburg branch of the Russian Chemical Society (in 1977 – 2012, A I Rusanov was Chairman of the Board of this branch; in 2012, V Yu Kukushkin was elected the chairman) and the great work of both the D I Mendeleev museum (Director of the museum is Professor I S Dmitriev from the SPbSU) and the Mendeleev Centre, which were of great importance for intensification of the 'chemical life' of the city and the University. The Mendeleev Readings, a scientific meeting highly important for the Russian chemical science, is held annually in Saint Petersburg at the SPbSU. In 2015, they were held for the 71th time.

Currently, the following key lines of research are developed at the Institute: physicochemistry of the surface phenomena and phase equilibria (A I Rusanov, N A Smirnova, V L Stolyarova and A I Viktorov), organometallic and coordination chemistry (V Yu Kukushkin, A B Nikol'skii, S P Tunik, N A Bokach and V P Boyarsky), organic and bioorganic chemistry (I A Balova, R R Kostikov, M A Kuznetsov, M S Novikov, A F Khlebnikov, A V Vasiliev, R E Trifonov, A G Shavva, M Yu Krasavin, L L Rodina, V A Nikolaev and V P Ananikov), chemical materials science, materials and nanostructured substances (A Yu Bilibin, R M Islamova, T B Tennikova, I V Murin, Yu S Tveryanovich, A M Toikka and R A Evarestov), electrochemistry and electrochemical sensors (Yu G Vlasov, V V Kondratiev, V V Malev and K N Mikhelson) and analysis of inorganic and organic compounds (I G Zenkevich, L A Kartsova, L N Moskvin, O V Rodinkov and V G Semenov).

The number of reviews submitted by employees of the Institute of Chemistry of the SPbSU for the dedicated issue of *Russian Chemical Reviews* far exceeds the size of the issue. Therefore, some of these articles have already been published in the earlier issues of 2015 (see *Russian Chemical Reviews* **4** 2015), the main fraction is published in this issue and the rest of papers will appear in the forthcoming issues. Furthermore, topical issues of the journal planned for the near future will contain reviews written by materials scientists of the Institute of Chemistry (executive editor is V L Stolyarova); another issue will be devoted to laser chemistry and contain reviews written by experts in this field from the SPbSU and the Moscow State University (the executive editors are Yu S Tveryanovich and A V Stolyarov).

The reviews that are to be published in 2015 can be classified into the following areas. Organic chemistry is presented by the reviews of A V Galenko, V V Pakalnis, A F Khlebnikov, M S Novikov and N V Rostovskii (the chemistry of isoxazoles), D V Dar'in and P S Lobanov (push-pull enamines in the synthesis of fused nitrogen heterocycles), O S Galkina and L L Rodina (the chemistry of excited states of the diazocarbonyl compounds), J J Medvedev and V A Nikolaev (new achievements of the rhodium carbenoid chemistry of diazo compounds), E A Popova and R E Trifonov (anomalous amino acids containing polynitrogen azolyl or azinyl heterocyclic moieties) and D S Ryabukhin and A V Vasilyev (synthesis of quinoline, isoquinoline and coumarin derivatives from acetylenic compounds). The research in analytical chemistry is reflected in the reviews of L A Kartsova and E A Bessonova (biomedical applications of capillary electrophoresis) and I V Gruzdev, I G Zenkevich and B M Kondratenok (derivatization in gas chromatographic determination of phenol and aniline traces in aqueous media). The research in physical and colloid chemistry is reflected in the reviews of A M Toikka, A A Samarov and M A Toikka (phase and chemical equilibrium in systems with esterification reaction), A G Bykov and B A Noskov (dilational surface rheology of polymer solutions), K N Mikhelson and M A Peshkova (advances and trends in ionophore-based chemical sensors) and A I Viktorov, M A Voznesenskiy and E A Safonova (spatial networks in solutions of aggregating molecules and their thermodynamic simulation); and nanochemistry is presented by the review of A V Povolotskaya, A A Manshina and A V Povolotskiy (hybrid nanostructures: synthesis, morphology and functional properties).

This issue of *Russian Chemical Reviews* comprises survey articles covering the significant research areas of the Institute of Chemistry, namely, the reviews of D V Dar'in and P S Lobanov (organic chemistry), I V Gruzdev, I G Zenkevich and B M Kondratenok (analytical chemistry), A G Bykov and B A Noskov (colloid chemistry), K N Mikhelson and M A Peshkova (physical chemistry), A V Povolotskaya, A A Manshina and A V Povolotskiy (nanochemistry).

The authors and the executive editor hope that the published reviews of the chemists of the Saint Petersburg State University will be of interest for broad circle of readers. This issue could also be of historical value as it demonstrates a slice of contemporary chemical research at a large Russia University — SPbSU.

Issue editor
Corresponding Member of the RAS
V Yu Kukushkin