

Aleksei Removich Khokhlov (on his 70th birthday)

DOI: <https://doi.org/10.3367/UFNe.2024.01.039636>

January 10, 2024 was the 70th birthday of one of the outstanding scientists of modern Russia, academician of the Russian Academy of Sciences (RAS), Aleksei Removich Khokhlov.

A R Khokhlov was born in Moscow in 1954. His father, physicist Rem Viktorovich Khokhlov, was later one of the founders of nonlinear optics and rector of Lomonosov Moscow State University (MSU) (1973–1977). A R Khokhlov's mother, Elena Mikhailovna, was a physicist, the daughter of the well-known physical chemist, specialist in the field of sorption processes, academician of the USSR Academy of Sciences, Mikhail Mikhailovich Dubinin.

In 1971, Aleksei Removich finished Physics and Mathematics School 2 (now the Second School Lyceum) in Moscow and entered the Faculty of Physics of MSU, which he graduated from with honors in 1977. Subsequently, A R Khokhlov continued working at the department. In 1979–1984, he worked as an assistant at the Department of Quantum Theory, then as an associate professor at the Department of Low-Temperature Physics (1984–1987), and in 1987–1993 as professor at the Department of General Physics. In 1993, Aleksei Removich headed the Department of Polymer and Crystal Physics.

A R Khokhlov was a student of Ilya Mikhailovich Lifshitz — one of the greatest Soviet theoretical physicists. Together with I M Lifshitz and A Yu Grosberg, he laid the foundation of statistical physics of macromolecules, which was being intensely developed in the 1970s. In particular, he formulated the theory of coil-globule transition in polymer systems based on the approach representing the conformational entropy of a chain as a density functional. The pioneering nature of the scientific work and high publication activity allowed Aleksei Removich to defend his candidate thesis ahead of schedule in 1979, and only four years later (at the age of 29), his doctoral thesis.

Throughout the 1980s–1990s, Aleksei Removich consistently demonstrated that the exceptional variety of polymer systems immediately surrounding us can be described in the language of physics. A R Khokhlov and his students developed the theories of the swelling and collapse of polymer gels, the phase behavior of solutions of rigid-chain, charged, and associating polymers, and DNA compaction. In particular, they showed the possibility of liquid-crystal ordering in solutions of rigid-chain polymers and the possibility of microphase layering in polyelectrolyte solutions. They revealed and described the ionomeric mode of behavior of ion-containing polymers in low-polarity media. The predicted phenomena were experimentally confirmed, which made A R Khokhlov's theoretical work classical.

Moreover, A R Khokhlov proposed several new methods of synthesis and modification of copolymers, leading to the



Aleksei Removich Khokhlov

formation of nonrandom successions of chain links imitating biopolymers, and also an original approach to creating macromolecules with required functional properties.

Beginning in the mid-1980s, along with theoretical studies, A R Khokhlov and his colleagues began using computer simulation methods. At the present time, computer simulation has become one of the fundamental non-experimental methods for describing the behavior of various polymer systems and high-molecular compounds.

At the same time, Aleksei Removich took an active part in a number of experimental studies in the physical chemistry of polymers. In particular, a method for selective blocking of water inflows in oil-producing wells was developed under his guidance. Moreover, in the 1990s, he initiated the start of large-scale experimental studies of polymer systems in 'green' supercritical fluids. This made it possible to develop methods, under his leadership, for producing ultrathin functional coatings, highly active stable catalysts, polymer-inorganic composites, highly porous matrices, 'breathing' water-repelling structures, and other promising materials that are now being used in a wide range of practical applications: from electrochemistry to medicine, where the purity of reaction media, their regenerability, and the possibility of fine tuning the characteristics of the obtained objects are critical.

Aleksei Removich has always paid great attention to the search for opportunities to equip his experimental laboratories with modern scientific equipment, even in periods of poor financial support for science; this allowed the same scientific team to experimentally confirm his theoretical predictions of the behavior of polymer systems.

In the more than 40 years of his scientific career, Aleksei Removich has published over 800 scientific papers, 10 books, and 25 reviews. Twelve doctoral and 65 candidate theses have been defended under his tutorship. His textbooks and manuals are well known to students learning polymer physics. The following works of his are widely known: *Statistical Physics of Macromolecules* (1989, together with A Yu Grosberg), *Physics in the World of Polymers* (1989, together with A Yu Grosberg), *Lectures on the Physical Chemistry of Polymers* (2000, together with S I Kuchanov), *Methods of Computer Simulation for Examination of Polymers and Biopolymers* (2009, Eds V A Ivanova, A L Rabinovich, and A R Khokhlov), *Introduction to Physico-Chemistry of Polymers* (2009, together with A A Askadskii), *Polymers and Biopolymers from the Viewpoint of Physics* (2010, together with A Yu Grosberg), *Fuel Cells with a Polymer Membrane: Materials for the Course on Fuel Cells* (2014, together with M O Gallyamov). His works have been cited more than 24,000 times, and the h-index is 72.

The pedagogical activity of A R Khokhlov is significant. Over the years, he developed and delivered lecture courses for students: Molecular Physics, Statistical Physics of Macromolecules, Fundamentals of Nanotechnology, Introduction to Polymer Physics, Advances in the Physics of Polymers and Crystals, and Modern Problems in Polymer Physics and Chemistry.

Aleksei Removich does important educational work. On his Telegram channel, he regularly acquaints readers with new achievements in science, shares his thoughts on current events in science, and also provides scientific and statistical data to help readers orient themselves to the life of the scientific-educational community.

Along with his achievements in fundamental research, noteworthy is A R Khokhlov's great contribution to the organization of scientific work. Since 1991, he has been head of the Laboratory of Physical Chemistry of Polymers at A N Nesmeyanov Institute of Organoelement Compounds of RAS. In 2008–2016, he worked actively as Vice Rector/Head of the Department of Innovations, Informatization, and International Scientific Relations/Innovation Policy and International Scientific Relations, and in 2016–2018 as vice-rector/head of the Department of Innovation Policy and International Cooperation of MSU. At the same time, Aleksei Removich organized several new laboratories. In particular, at the Faculty of Physics of MSU, the Laboratory of Liquid Crystals was organized. Since 1995, Aleksei Removich has been director of the Center of Collective Use, The Physical Methods for Studying the Structure of Matter; since 1997, director of the educational scientific center Chemistry and Physics of Polymers and Thin Organic Films; and since 2013, head of the Center of Electrochemical Energetics. He was also chair of the Science Council under the Ministry of Education and Science of Russia (2013–2017) and co-chair of the Science Council under the Moscow Department of Education and Science (2014–2022). At the present time, he is head of the Academic Council for nominations for the Physical World of the Sber Scientific Award (since 2021).

Aleksei Removich Khokhlov played an important role in the development of the Russian Academy of Sciences. In 1990, he was elected a corresponding member of the USSR Academy of Sciences and, in 2000, a full member of RAS in the Division of Chemistry and Materials Science. In 2008–2022, he was a member of the RAS Presidium; in 2017–2022, vice-president of RAS; he was elected deputy academician secretary of the Division of Chemistry and Materials Science; currently, he is a member of the Bureau of this division, chair of the Academic Council on High-Molecular Compounds of RAS (since 2002, Deputy Chair 1992–2002). He was also chair of the RAS Commission on the Popularization of Science (2017–2022), chair of the Scientific Publishing Council of RAS (2017–2022), chair of RAS Commission on Scientific and Organizational Support for Basic Schools of RAS (2017–2022).

For his weighty contribution to science, Aleksei Removich has received many domestic and international awards. He is a laureate of the Lenin Komsomol Prize (1982) and of the Russian Federation State Prize (2007). He was awarded the Medal of the Order of Merit for the Fatherland, II degree (2005) and the Order of Honor (2020). He was awarded the Lomonosov Prize for pedagogical activity (2005) and the SciVal/Scopus Prize (Russia) for the outstanding contribution to science in the field of chemistry (2012). In 2010, A R Khokhlov became the LXVIth Mendeleev reader. Among his international awards, he received the Humboldt Prize (1992), the Wolfgang Paul Prize (2001), the International Prize in the field of Polymer Technologies (Netherlands, 2005), the Knight's Cross of the Order of Merit (Germany, 2012), the International Prize of the Japanese Society of Polymer Science (2015), and the Gerhard Kanig Prize (2016).

For his disciples and colleagues, Aleksei Removich is always an example of a scientific mentor with the highest moral and ethical standards, capable of helping and providing support in difficult situations. He always displays decency, goodwill, and diplomacy. We sincerely wish the hero of the day many years of a prosperous and joyful life, undying creative potential, and fruitful scientific activity!

*V V Vasilevskaya, M O Gallyamov, A Yu Grosberg,
R A Gumerov, A V Emel'yanenko, V A Ivanov,
E Yu Kramarenko, I I Potemkin, O V Rudenko,
A M Sergeev, O E Philippova, D R Khokhlov*