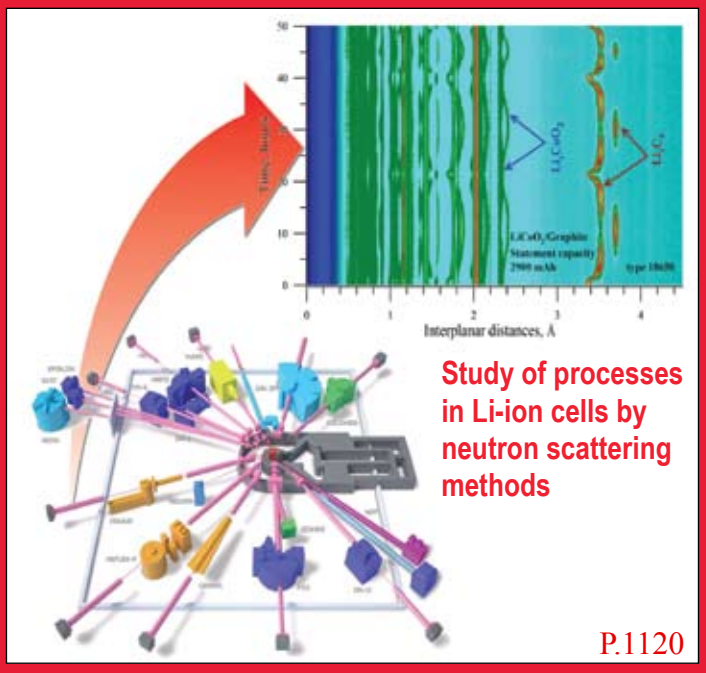
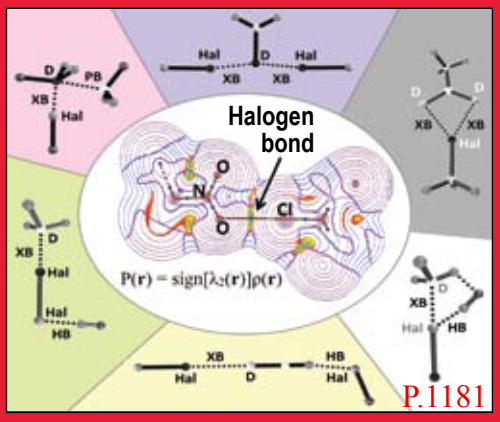
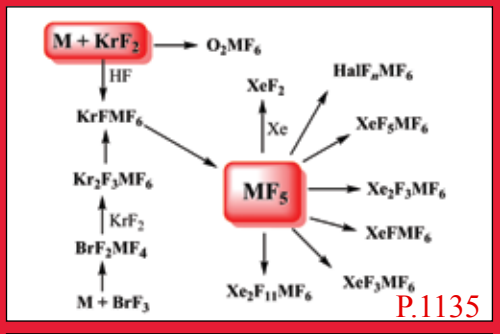
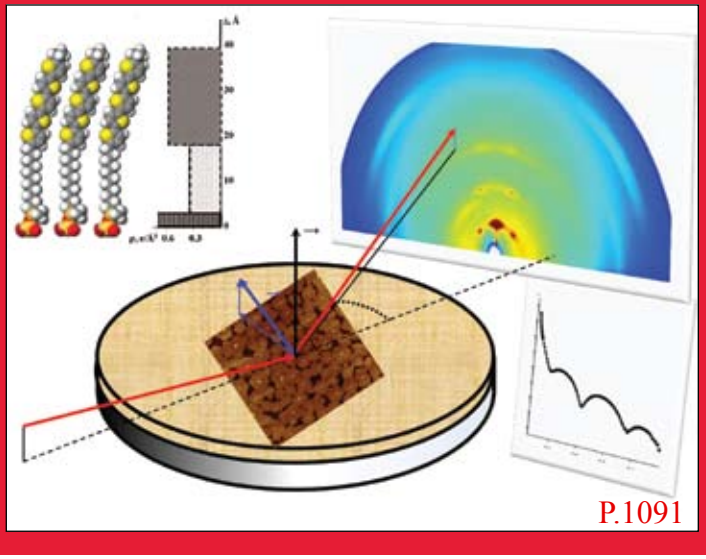
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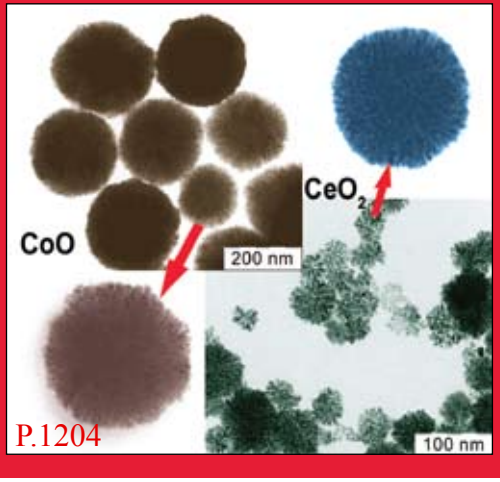
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Reviews on current topics in chemistry

International Year of Crystallography

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The year 2014 as the International Year of Crystallography

In accordance with the resolution of the UN General Assembly of July 3, 2012, the year 2014 coming to its end was named the International Year of Crystallography. The official opening of the Year took place on January 20 and 21, 2014, in the UNESCO headquarters in Paris and was attended by prominent scientists and young researchers from many countries including Russia.

Historically, crystallography has passed the way from descriptive mineralogy through chemical analysis (study of the mechanisms of crystal formation and growth) to physics (X-ray diffraction analysis, physical material science) and then to biology (atomic and molecular structure of biological objects). Currently we are moving from crystals to low-ordered media, from three-dimensional structures to one- and two-dimensional structures, from mimicking the Nature to artificial design of objects having no natural analogues. The possibility of this development is provided, first of all, by the fact that currently crystallography is not merely the sum of certain fields of science but, in essence, represents a convergence, as it combines various areas of research such as geology, chemistry, physics and biology. Crystallography underlies the design of all new materials ranging from aircraft parts to vigorously developing areas of nanotechnologies and biotechnologies.

Currently, apart from detection of spatial positions of single atoms to a sub-Angstrom accuracy, it has become possible to track the movement of atoms with a femtosecond time resolution. This can be done, for example, during natural disasters or chemical reactions.

Actually, owing to the advent of X-ray free electron laser (XFEL), one can consider the creation of 4D crystallography with time being the fourth coordinate. This opens up fundamentally new opportunities for elaboration of industrial processes relying on visualization of atomic motion during chemical reactions.

The significance of the scientific achievements related to crystallography is confirmed by the fact that the Nobel Prize was many times awarded for investigations in this important field, which is still a fruitful soil for new promising fundamental and applied research.

The International Year of Crystallography is timed to the 100th year anniversary of awarding the Nobel Prize in Physics to Professor Max von Laue from the Frankfurt am Main University for discovery of X-ray diffraction by crystals and thus it marks a century of modern crystallography and 65 years from the foundation of the International Union of Crystallographers.

While recognizing the leading role of the International Union of Crystallographers in the coordination and support the development of crystallography at international, regional and national levels, we would like to emphasize that the International Year of Crystallography is meant to increase the understanding of the significance of crystallography and to encourage wide-scale access to new knowledge and achievements in this field. The International Union of Crystallographers maintains a special website announcing the events related to the International Year of Crystallography. The foundation of a new open-access journal — International Union of Crystallographers Journal — was the first of such events.

In Russia, crystallography has a glorious history and great plans for the future. Great Russian scientists M V Lomonosov, A V Gadolin and E S Fedorov deservedly belong to founders of theoretical crystallography and crystal chemistry. G V Wulf derived the principal equation of X-ray diffraction on crystals independently of W Bragg. Academician A V Shubnikov, follower of G V Wulf, one of the founders of the International Union of Crystallographers, organized the world first Research Institute of Crystallography in 1943 and the Russian journal *Kristallografiya* in 1956. The English-translated version of the journal is called *Crystallography Reports*. He also organized the world's first industrial production of quartz, Rochelle salt and other technologically important crystals. Academician N V Belov, President of the International Union of Crystallographers from 1966 to 1969 and the author of world known studies dealing with mineral structure, inorganic crystal chemistry and theory of symmetry, worked at the same Institute. The Russian first laboratory for protein crystallography was also founded at the Institute of Crystallography by initiative and under the direction of Director of the Institute Academician B K Vainshtein. Later, the next Director of the Institute of Crystallography Corresponding Member of the Russian Academy of Sciences (RAS) M V Kovalchuk established the world's first Centre for Convergent NBIC (nano-, bio-, information and cognitive) Science and Technology. A weighty contribution to the development of crystallography, crystal physics and crystal chemistry of various classes of compounds was made by representatives of above-mentioned top Russian schools in crystallography.

In honour of the International Year of Crystallography, special national and international crystallographic conferences and meetings organized by the Russian Academy of Sciences, National Research Centre 'Kurchatov Institute', St Petersburg State University and the Russian Foundation for Basic Research were held in various Russian cities: XVIII International Conference on Crystal Chemistry,

X-ray Diffraction and Spectroscopy of Minerals in Ekaterinburg; VII National Crystal Chemical Conference in Suzdal; International Conference 'Graphene: The Molecule and 2D Crystal' in Novosibirsk; International Conference 'Neutron and Synchrotron Radiation Scattering in Condensed Media' in St Petersburg.

This issue of the *Russian Chemical Reviews* journal preliminarily summarizes the Year of Crystallography by publishing reviews in the topical areas of crystallography and crystal chemistry written by both eminent and young Russian scientists. The issue includes reviews analyzing the available published data on two most important areas of modern crystallography: methods for material structure investigations and mechanisms of formation of crystals with non-classical type of bonding.

The review of M A Shcherbina, S N Chvalun, Corresponding Member of the RAS S A Ponomarenko and Corresponding Member of the RAS M V Kovalchuk considers modern experimental methods for investigation of the structures of nanometer films made of various materials, most of all, by X-ray reflectometry, grazing incidence scattering and X-ray standing wave method.

The review of A M Balagurov, I A Bobrikov, N Yu Samoylova, O A Drozhzhin and Corresponding Member of the RAS E V Antipov is devoted to application of neutron diffraction methods, small angle and inelastic neutron scattering and neutron reflectometry for structure analysis based on materials used to manufacture small-scale lithium batteries.

Sh Sh Nabiev, V B Sokolov and B B Chaivanov consider the molecular and crystal structures of noble gas compounds. These unusual compounds, synthesized for the first time more than fifty years ago, now find extensive use in various fields of nanotechnology.

The review of E V Bartashevich and V G Tsirelson deals with analysis of structures and properties of complexes and crystals with halogen bonds. Characterization of these bonds is a debated issue in up-to-date chemistry. The authors discuss problems that give rise to contradictions in interpretation of halogen bonds in different compounds.

Finally, the review by V K Ivanov, P P Fedorov, A Ye Baranchikov and Academician V V Osiko is devoted to generalization of investigation results of non-classical crystal growth by the particle aggregation mechanism. These growth models are used in material science for development of syntheses of nano- and biomaterials where traditional concepts are often inapplicable.

Russian Chemical Reviews plan to continue publishing papers on the topical aspects of modern crystallography in the subsequent issues.

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