ON THE 150TH ANNIVERSARY OF THE PERIODIC TABLE OF CHEMICAL ELEMENTS

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ABSTRACT

A brief review of the prehistory of the appearance of an outstanding discovery in the field of physics and chemistry – the creation of the Periodic Table of Chemical Elements by the Russian scientist Dmitry Ivanovich Mendeleev is presented. He also first formulated a periodic law, on the basis of which the classification of the sections of the elements in modern chemistry was built.

ON THE BLOCK STRUCTURE AND ELECTRON CONFIGURATION OF CHEMICAL ELEMENTS

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ABSTRACT

This article discusses the main problems of the classification of chemical elements in current versions of periodic systems of elements. It has been shown that despite many attempts to resolve these problems, some controversial issues of the present system remained unsolved, such as the placement of hydrogen and helium, elements of main groups with variable valence, some transition and post-transition elements, lanthanides and actinides, as well as the relationship between the numbering of groups on the one hand, and chemical properties of elements on the other hand, etc. To overcome the contradictions of the conventional classification system of elements, an updated approach was used, based on consideration of block structure, electron configuration and filling order for elements of the given group. Based on this approach, all elements were divided into S-, P-, D-, F- and DF-blocks, depending on the presence of the last filled s-, p-, d-, f- or df-orbital. Besides, updated names and numbering of the groups was proposed. In addition, an updated design of the periodic table of elements was developed.

PERIODIC SYSTEM OF CHEMICAL ELEMENTS AND ITS PARADOXES

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ABSTRACT

This review article contains a brief historical overview of the discovery of the periodic law of chemical elements. Various attempts were made to classify elements using the rule or the law of triads and octaves, as well as by means of valence and atomic weights of elements. Many other attempts were performed to systematize the chemical elements, but only Russian chemist Dmitry Mendeleev succeeded in formulate the periodic law of the elements and to build the

table of elements with periodically repeating chemical properties depending on the atomic weight. The modern versions of the periodic system of elements are considered. Furthermore, the basic principles and paradoxes of this system are discussed.

ON THE BASIS OF THE PERIODIC ELEMENT SYSTEM

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ABSTRACT

It is shown that the basis of the periodic system of elements is a cyclical change in the moment of distribution of valence electrons as one of the parameters of the inhomogeneity of the system. An approximate expression of this moment is found through the degree of filling of the outer shell of an atom and on its basis a graphical representation of a periodic law is proposed, taking into account its number, charge, atomic radius and distribution of valence electrons. The graph reveals the existence of additional periods ending in inert metals, not only in known elements but also in the group of lanthanides and actinides, allowing them to be organically incorporated into the periodic system. The consistency of such a representation of the classical and quantum models of atoms is shown.

DISSOCIATION CONSTANTS OF HYDRATED OXIDES OF CHEMICAL ELEMENTS IN THE D.I. MENDELEEV'S PERIODIC SYSTEM

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ABSTRACT

This article contains theoretically calculated the orbital and true radii of atoms and ions. It is shown that their physical properties change with an increase in the atomic number of elements strictly naturally with a complication of the structure of their electronic shells. This is reflected in the primary, internal, and secondary periodicity. The basic laws of these changes are well traced even on changes in the orbital radii of atoms. They make it possible to understand the physical meaning of the relationship between the remaining properties of atoms and the structure of their electron shells. In this case, the need arises to consider the structural features of not only external but also previous electronic shells, which to no small extent determine such energy properties of atoms as ionization energies and electron affinity. Based on the orbital and true radii of atoms and ions, ionization energies and electron affinities for various atoms, including those obtained synthetically, that were absent in the literature, were calculated. Based on these data, the force's characteristics of element ions in various oxidation states and different coordination environments and spin states are calculated.

A relationship was found between the force's characteristics of ions and the dissociation constants of hydrated oxides of chemical elements of the Periodic system. A relationship describing the relationship is proposed $pK_{a(1)}$ with the value of the force's characteristic of the ion (γ_i^{n+}), oxidation state (n) and group numbers (m), in which this element is located:

$$pK_{a(1)} = d_0 - d_1 \cdot (m + n) + \frac{d_2}{\gamma_i^{n+}} \cdot 10^{d_3 \cdot (m+n)}$$

where d_i – empirical constants. The relationship between the constants of sequential dissociation of polybasic acids has been established. Similar patterns were found for the basic

properties of hydrated oxides of chemical elements. Correlation dependencies between $pK_{b(1)}$ and force's characteristics of ions.

THE ROLE OF THE MODIFIED COULOMB ENERGY IN THE BINDING ENERGY EQUATION FOR FINITE NUCLEI

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ABSTRACT

A modified Coulomb energy equation has been derived and investigations on its role in the binding energy equation of the finite nuclei have been done. A comparison of the values of the Coulomb binding energy obtained using the modified Coulomb energy equation with other known Coulomb energy expressions was carried out. Owing to the fact that the calculated Coulomb energy values are not exact, we chose an exponential function as our correction term. Our calculations show that Coulomb energy is one of the major contributors of the nuclear binding energy in heavy nuclei due to the nuclear repulsion between the protons that increases with a corresponding increase in nuclear size. Proton-proton repulsion within the nucleus provides the long-range forces that multiply and permeates throughout the entire volume of the nucleus, hence contributing over 80%, of the Coulomb energy experienced at the nuclear surface. The Coulomb energy per nucleon, in this study, was found to increase exponentially with an increase in the mass number. Analysis of the results showed some slight variation among the modified Coulomb energy equations and this was attributed to the difference in the values of the nuclear radius parameters used.

CANONICAL TRANSFORMATION FOR A MIXTURE OF BOSONS AND FERMIONS

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ABSTRACT

There exist canonical transformations for a system of fermions, or for a system of bosons. Condensates have been observed for mixtures of bosons and fermions. A canonical transformation to deal with the mixture of bosons and fermions has been developed.

THE NEW DEVICE FOR STORAGE AND GENERATION OF HYDROGEN

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ABSTRACT

In this paper, based on the analysis of possible ways of storing and transporting hydrogen, we proposed to use the interaction between the active metals, or their alloys, or metal hydrides,

with water for hydrogen generation. The practical realization of this approach has been proposed the construction of the device of hydrogen storing and generating for powerful engines and vehicles. The functioning of the recommended equipment is to hydrogen generation by reacting the active metals, or their alloys, or metal hydrides with water in a polar aprotic organic solvent. From these products, it has been proposed to form the cartridges with internal through holes — cartridges placed in the hydrogen generator. The polar solvent pumped through the hydrogen generator in which it reacts with the material of the cartridge. At this solvent is added the water in a controlled manner and used for the reaction with the cartridge material for hydrogen release. Hydrogen, after separation of the liquid phase, flows into the fuel system of the internal combustion engine. The spent solvent is pumped into the solvent intake and storage system and, subsequently, the solvent is replaced when the cartridge is replaced. The system can operate in a closed-loop in the case organization of gathering and recycling of waste materials for reuse.

SOFT SHELLS IN AIR FLOW:
EXPERIMENTS AND COMPUTATIONAL MODELS
Part II

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