

## **EXPERIMENTAL RESEARCHES OF MICROWAVE ELECTROMAGNETIC ACTIVITY OF THE HUMAN BRAIN**

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### **ABSTRACT**

The discovery of microwave radiation of the human brain of the UHF/SHF range (from 1.5 to 4.5 GHz) with a signal power of -130 dBm .. -100 dBm ( $1e^{-15}$  ..  $1e^{-13}$  W) opens a new information channel for its diagnosis. It will allow developing and creating appropriate instruments for real-time analysis of microwave its bioelectrical activity under normal and pathological conditions, diagnosing a number of functional and emotional states of a person and a number of mental disorders and mental illnesses, creating a new information channel for biofeedback of the human brain and new type of the brain-computer neurointerface.

## **ON REACTIVITY OF CHEMICAL ELEMENTS**

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### **ABSTRACT**

In this paper, data on the electron configuration of atoms was used to predict the reactivity of chemical elements belonging to different blocks, S, P, D, F, and DF. The study of elements of S-block and some elements of P- and D-blocks showed that the total amount of outer electrons usually correspond to a maximum number of reactive valent electrons. Exceptions to this rule are described. The phenomenon of the passivity of paired s-electrons for higher elements of P-block was mentioned. The correlation between the total amount of outer electrons and an average number of reactive electrons for the elements of D8–D12 groups was found. The specific electron structure was studied to predict the reactivity of lanthanides and actinides belonging to F-and DF-blocks. In addition, the reactivity of outer electrons of various suborbitals (s, p, d, and f) was discussed.

## **INCOMMENSURATE CRYSTALLIZATION OF NEUTRON MATTER IN NEUTRON STARS**

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### **ABSTRACT**

The composition of the neutron stars from its surface region, outer-core, inner-core and to its center is still being investigated. A few models have suggested that the matter at the surface region of the neutron star is composed of atomic nuclei that get crushed under extremely large pressure and gravitational stress, and this leads to the creation of solid lattice with a sea of electrons, and perhaps some protons, flowing through the gaps between them. However, the neutron star is the highly compact crystalline system, and in terrestrial materials under pressure, many examples of incommensurate phase transitions have been discovered. Consequently, the properties of incommensurate crystalline neutron star have been studied. One model describes the core as superfluid neutron – degenerate matter, mostly, composed of 90% neutrons, and a small percentage of protons and electrons, 10%. Using principles of quantum statistical mechanics, the specific heat and entropy of the incommensurate crystalline neutron star have been calculated assuming that the temperature of the star may vary between  $10^6\text{K}$  to  $10^{12}\text{K}$ . Two values for the temperature  $T$  that have been arbitrarily chosen for which the calculations have been done are  $1.7 \times 10^6\text{K}$  and  $1.7 \times 10^{10}\text{K}$ . The values of specific heat and entropy decrease as the temperature increases, and also, their magnitudes are very small. This is in line with the second law of thermodynamics.

## **ALUMINUM HYDROXIDE BASED ANION EXCHANGE MATERIALS**

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### **ABSTRACT**

Inorganic sorbents, in comparison with ordinary organic ion exchangers, have higher selectivity, radiation, thermal, and chemical stability. Inorganic ion exchangers are universal materials exhibiting both cation exchange and anion exchange properties. In this work, using aluminum hydroxide (AHO) as an example, we study the possibility of expanding the range of metal oxyhydrates that can serve as the basis to produce inorganic anion-exchange materials. The properties of aluminum hydroxide largely depend on the method of its production. This phenomenon is associated with a different state of  $\text{Al}^{3+}$  ions in aqueous solutions during hydrolysis. The most potent effect on the structure and ion-exchange properties of aluminum hydroxide is exerted by the introduction of alloying elements into its composition. Isomorphic substitution of a part of Al(III) ions in the structure of aluminum hydroxide with ions with a higher charge (Ti(IV), Zr(IV), or W(VI)) leads to an increase in the content of exchangeable OH-groups in the resulting material. The synthesized materials are amorphous substances, to study their structure; the method of diffuse X-ray scattering was used. The Gibbsite structural motif is determined, and structural changes occurring under the influence of various factors, and synthesis conditions are analyzed. By optimizing the composition of the material, it is

possible to improve its sorption characteristics significantly. AAW-0, AAZ-0, and AAT-0 anion exchangers synthesized based on hydrated aluminum oxide can be used to purify weakly acidic electrolyte solutions from anionic impurities in the dynamic mode of repeated sorption-desorption cycles. Materials based on mixed hydrated oxides of various elements can also be used as catalyst supports. Their anion exchange properties allow a wide range to vary the number of different anions introduced into the solid phase and, accordingly, to regulate the number and state of active catalytic sites.

## **DEVELOPMENT OF TECHNOLOGY TO PRODUCE DECONTAMINANTS AND DETERGENTS FOR THE NUCLEAR INDUSTRY**

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### **ABSTRACT**

In this work, we assessed the possibility of using a new detergent with the conditional name MDS for deactivation of various surfaces, equipment, and workwear. A review of the deactivation methods currently used is reviewed. It has been shown that the most typical pollutants are mixtures of radionuclides  $^{137}\text{Cs}$ ,  $^{144}\text{Ce}$ ,  $^{144}\text{Pr}$ ,  $^{90}\text{Sr}$ , and  $^{239}\text{Pu}$ . All these elements are prone to the formation of chelate complexes. Therefore, complexing substances should be an essential component of deactivation solutions that form stable, water-soluble complex compounds with these radionuclides. When creating the recipe, the complexing agents were selected so that they had the most durable complex compounds with the alleged pollutants. For research and testing in real conditions, three types of special detergents of various compositions and with the conditional name MDS were prepared. The composition of these preparations consists mainly of an optimized mixture of surfactants, complexing agents, corrosion inhibitors and processing aids. The studies were conducted to evaluate the possibility of using these funds for deactivation of premises, equipment, washing clothes in the Federal Unitary Enterprise "Mayak" and at its branch NIKIET in town Zarechny at Beloyarskyaya Nuclear Power Station in Russia. The effectiveness of deactivation was judged by the amount of residual contamination of the surface of the samples. The deactivating ability of MDS preparations for stainless, carbon steel, and plastic contaminated with  $\beta$ - and  $\alpha$ -emitting nuclides was tested. The possibility of using MDS detergents for the deactivation of platinum ampoules stored as radioactive waste was assessed. The possibility of using MDS detergents for deactivation of fabric materials, including underwear and work clothes, was also evaluated. The tests showed the high efficiency of the developed detergent MDS, in comparison with the existing and currently used deactivation agents.

## **SUPRAMOLECULAR STRUCTURE OF CELLULOSE IN COTTON FIBERS OF VARIOUS ORIGINS**

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### **ABSTRACT**

**In this article, fifteen varieties of cotton fibers *G. hirsutum* and ten varieties of cotton fibers *G. barbadense* of different origins have been studied using WAXS and several other methods. Various characteristics of supramolecular structure of these cellulose fibers were obtained, such as crystallinity, sizes and paracrystallinity degree of crystallites, parameters of a crystalline unit cell, along with microfibrillar angle (MFA) and coefficient of orientation ( $K_0$ ). From the results, it follows that cotton fibers of *G. barbadense* have a noticeably more ordered structure than the fibers of *G. hirsutum*. In particular, cotton fibers of *G. barbadense* were denser and more crystalline, crystallites in the cellulose of *G. barbadense* were longer, wider, denser and less disordered than in cellulose of *G. hirsutum*. Furthermore, measurements of MFA and  $K_0$  showed that microfibrils in cotton fibers of *G. barbadense* are better oriented. The revealed structural features of *G. barbadense* cotton fibers explain their higher density, strength, and elasticity compared to *G. hirsutum* fibers.**