3. Alekseenko, P. I., Korovin, S. D., Saharov, E. S. (2002). Using of low-energy high current nanosecond electron beams for radiological sterilization of medical powders. Pharmaceutical Chemistry Journal, vol. 36, no. 12, pp. 29-30. Retrieved December 28, 2016, from http://chem.folium.ru/index.php/chem/article/view/2643
4. Rostov, V. V., Alekseenko, P. I., Vihodcev, P. V. (2012). High current repetitively-pulsed electron direct action accelerator as way of sterilization of single-use medical items. Bulletin of the Tomsk Polytechnic University, vol. 321, no. 2, pp. 48-53. Retrieved December 21, 2016, from http://www.lib.tpu.ru/fulltext/v/Bulletin_TPU/2012/v321/i2/11.pdf

APPLICATION OF AN ELECTRICAL DISCHARGE IN SALINE FOR REMOVAL OF BENIGN TUMORS

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Surgical instruments using plasma are widely used in various surgical procedures. The advantages of high-frequency plasma instruments are simultaneous hemostasis and dissection of tissues, and the ability to coagulate large vessels. A positive effect in this case is achieved by heat generation in the tissues. However, the temperature reaches 500 ° C and tissue is damaged to a depth of 5 mm [1]. The alternative method, which has recently begun to enter into medical practice is the removal of tissue using cold plasma. This method was developed by ArthroCare Co and named coblation [2].

Physical and chemical processes occurring in the plasma formed in a liquid are important for the understanding of the phenomena observed in surgical instruments. As the working fluid saline is used, which is prepared from sodium salt dissolved in water with a concentration of 0.9 g / l. The current passing through the electrolyte produces heat, which leads to the formation of a thin layer of bubbles, which covers the electrode. When an electrical discharge is created, gas in bubbles ionized.

Investigation of the device characteristics was conducted in saline solution. The output pulse of the device is biphasic with varying amplitude. The pulse repetition rate is f = 25 kHz. The current is measured via a shunt (RI = 1.5 ohms). The voltage and current were recorded by a digital oscilloscope. The voltage was varied between 50 – 300 V. When voltage is applied, the current value is determined by the conductivity of the electrolyte. As electrolyte is heating, gas bubbles near the electrode are formed. As a result, the current value is determined by the characteristics of the discharge.

The device is developed for biological tissue removing. The tests show that the resistance of the gap between the electrodes in the electrolyte increases with the applied voltage. Upon reaching a voltage ~180 V, its resistance rises sharply due to the formation of gas bubbles. Then therein a discharge is developed and a plasma is formed.

REFERENCE

1. Absten T 2002 Practical electrosurgery for clinicians (Professional Medical EducationAssociation, Inc.).
2. Sergeev V and Belov S 2003 Coblation Technology: a New Method for High-Frequency Electrosurgery Biomedical Engineering 37 22-25

NICKEL ISOTOPE SEPARATION OCCURING FILLING OF GAS CENTRIFUGE CASCADE WITH DIFFERENT STAGE NUMBER

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During the operation of gas centrifuge (GC) cascade for the multicomponent isotope mixture (MCIM) separation there are nonstationary hydraulic and separation processes. It is necessary to ensure safety of the equipment and to minimize losses of cascade productivity during nonstationary processes.

In this regard, actual task is full-scale research of nonstationary processes. It is advisable to study the nonstationary processes by mathematical modeling. Known mathematical models [1-3] describe nonstationary hydraulic processes for only long cascade and nonstationary separation processes in the case of stationary hydraulic parameters of cascade. For elimination of these disadvantages we had developed the mathematical model of nonstationary hydraulic and separation processes occurring in GC cascade for the MCIM separation [4-6]. Earlier we had done verification of developed mathematical model as an example silicon and germanium isotope separation. Filling GC cascade with process gas precedes isotope separation mode. So far, a modeling of filling cascade was not carried out.

The results of research nickel isotope separation occurring of filling GC cascade with different stage number are shown. Nickel isotopes are used for nuclear physics experiments and production radioactive isotopes (for example, ^{62}Ni stable isotope is used as source material to produce ^{63}Ni radioactive isotope).

REFERENCE

1. E.V. Levin, N.I. Laguntcov, G.A. Sulaberidze Journal of Engineering Physics, 43, 456-462 (1982)
2. V.M. Vetcko, etc. Isotopenpraxis, 18, 288-293 (1982)
3. A.Yu. Smirnov, A.K. Bonarev, G.A. Sulaberidze, V.D. Borisevish, S. Zeng, D. Jiang, Y.N. Zhang IOP: Conference Series, 751, 012006 (2016)
4. A.A. Orlov, A.A. Ushakov, V.P. Sovach Journal of Engineering Physics and Thermophysics, 90, 2, 258-265, 2017
5. A.A. Orlov, A.A. Ushakov, V.P. Sovach MATEC Web of Conferences, 92, 01033, 2017

MODELING OF NONSTATIONARY PROCESSES DURING SEPARATION OF MULTICOMPONENT ISOTOPE MIXTURES

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Isotopically-modified materials, in which the isotope content of chemical elements is different from natural values, have found wide application in various fields of the economy (nuclear power engineering, medicine, fundamental research, etc.). The composition of isotope mixtures changes in a separation process. The growing demand for isotopically-modified materials has resulted in an amount of research aiming to improve the technology of isotope mixture separation. One of the main negative factors decreasing the effectiveness of the MCIM separation process is nonstationary hydraulic and separation processes in gas centrifuge (GC) cascade. The research into the effects of nonstationary processes on the efficiency of MCIM separation seems to become even more important. An experimental approach in this case appears to be quite costly, so it is strongly recommended that nonstationary processes should be investigated by mathematical modeling.