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Mass analysis of the gas composition after the electrical explosion of copper spirals with a dielectric coating

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Abstract. Mass analysis of the composition of gases in atmospheric air after an electrical explosion of copper spirals with a dielectric coating was carried out. New components with masses of 20, 29, and 81 u was discovered. Proposed the hypothesis that when exposed to strong pulsed magnetic fields in the dense plasma containing oxygen atoms and a natural mix of hydrogen isotopes, may increase the rate of plasma-chemical reactions forming molecules of heavy water relative to the rate of formation of the molecules of ordinary water.

Electrical explosion of copper spirals is of interest for the formation of plasma clots, which some time can exist without makeup from an external source of energy. The choice of copper as a material for spirals is due to the fact that copper has high electrical conductivity and a relatively high mechanical tensile strength. The use of spirals as the configuration of the conductors electrically explode due to the fact that before an electrical explosion inside the coils creates a stronger magnetic field compared to that created by electrical explosion of linear conductors. In the moment of electric explosion of spirals a dense plasma is formed, and this plasma is subjected to a strong magnetic field which decreases rapidly. In this case, inside the strong plasma vortex electric field arises that can form an inductive discharge.

Of particular interest is the placement of the spirals in the form of toroidal structure \[1\]. In this case a toroidal current layer can be formed \[2\], which can cause runaway electrons, which can become relativistic. In any case, not only the thermal energy is introduced into the plasma, but the electromagnetic energy injected into the plasma through inductive discharge accompanying the electric explosion of spirals. The result can be expected various effects associated with the interaction of particles of a dense plasma under a strong magnetic field and pulsed inductive discharge. The aim of this work was the study of the effects of electrical explosion of copper spirals from the point of view of the composition of the formed gases.

Experiments on electric explosion of copper spirals were carried out in air atmosphere using the stand containing the textolite base, which was assigned to four turns for 10 turns of enameled copper wire with a diameter of 0.75 mm (figure 1). These spirals have been installed in such a way to form the overall toroidal magnetic field. The largest ring size was 32 mm (small radius was 4 mm; the large radius was 12 mm). Electrically spiral was connected in parallel, adjacent spirals had opposite direction of windings (left and right). Wire was wrapped in capacitor paper with a thickness of 0.05 mm for greater resistance to winding short circuit. As a source of pulsed current was used upgraded installation INGIR-Mega-15 \[3\] with the following parameters: the
maximum charging voltage of 450 V, the maximum amplitude of the discharge current of 400 kA, the maximum pulse discharge current is 500 µs, the slew rate of current is 3 kA/µs, capacity is 1.12 F. Electrical explosion of copper spirals with a dielectric coating was carried out with the following parameters: the charging voltage was 450 V, the amplitude of the current was 40 kA and pulse duration of discharge current was 300 µs. In result of electric explosion was obtained by the plasma clot with the lifetime of about 0.06 s (figure 2). In this figure, the first frame shows a test chamber of the experimental setup before the beginning of the process of electric explosion of spirals and the second frame shows the plasma clot after electric explosion after 0.058 s.

Gas samples were taken from the test chamber before an electrical explosion and after the explosion and went to mass analysis (for 6 s). Mass analysis was carried out using monopole mass analyzer [4]. The sample was introduced into the ion source in the gaseous state, and then made its ionization by electron impact with an electron energy of 80 eV. The pressure of the residual gas in the vacuum chamber of the mass analyzer was 0.005 Pa. The initial energy of injected ions was 4 eV. Spectrum scanning was carried out in the range 10–100 u. The spectrum of the sample “before the explosion” presents components of atmospheric air, and components of contamination of the vacuum system with masses more than 50 u (figure 3). In the spectrum of the sample “after the explosion” we have seen increased content of nitrogen ions, and component masses 20 u, 29 u, 81 u (figure 4).

Shows the spectra may indicate some features of plasma-chemical reactions in the process of electrical explosion of copper spirals with a dielectric coating. Here special attention is drawn to the mass peak of 20 u. In addition to the HF molecules, such molecules possess mass of

**Figure 1.** Photo booth with a toroidal set of copper spirals with a dielectric coating.
Figure 2. Sample shots video of the process of electrical explosion of installed copper toroidal coils with a dielectric coating.

Figure 3. Spectrum of residual gas in the explosion chamber before the explosion.

heavy water. It can be assumed that the appearance of molecules of heavy water may be due to some resonant processes in plasma-chemical reactions in the presence of a powerful pulsed magnetic field and inductive discharge. It is possible that in this case the speed of reaction of formation of molecules of heavy water from natural mixture of isotopes of hydrogen and oxygen can be substantially higher compared to the rate of formation of the molecules of normal water. This hypothesis has a right to exist because in the proposed method of intensive energy flow
Figure 4. Spectrum of residual gas in the explosion chamber after the explosion.

on substance, the peak value of the magnetic field inside the copper coils is estimated at about 5 T, and the powerful induction discharge that occurs when a rapid change of this magnetic field capable of forming plasma current layers with a high current density.

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