Transmutations by Nanosecond Electromagnetic Impulses

Valeriy Vadimovich Krymskiy^{1*}, Vladimir Fedorovich Balakirev² and Natalia Valereyvna Plotnikova³

1. Energy Department, South Ural State University, Chelyabinsk 454080, Russia

2. Institute of Metallurgy of the Ural Separation of the Russian Academy of Sciences, Ekaterinburg 620016, Russia

3. Computer Engineering, Control and Communication Department, South Ural State University, Chelyabinsk 454080, Russia

Abstract: Some experiments on radiation of hydrocarbons and the alloys including Bismuth and Lead by power nanosecond electromagnetic pulses are described. The list of the used equipment and technique of experiments are given. The result of these experiences is change of a chemical composition of the irradiated samples in comparison with the initial ones. Conversion of part of Bismuth to Lead is observed. The hypothesis of such changes is made.

Key words: Transmutation, electromagnetic, pulse, nanosecond, Lead, Bismuth.

1. Introduction

The results of influence of powerful NEMI (nanosecond electromagnetic impulses) on fusions of metals and solutions of salts are given [1-3]. The essence of the method is that fusion of metal or water solution is affected by electromagnetic impulses lasting less than 1 ns with an amplitude more than 5 kV. The impulse form is shown in Fig. 1.

Impulses are generated by special generators which have small dimensions and weight, consume the power from a network less than 100 W. In our researches generators of FID-Technology firm (St.-Petersburg) were used. Amplitude of impulses is 7-15 kV, duration is 1 ns, the frequency of repetition is 0.1-1 kHz.

The impulse from the generator exit is transferred on the radiator. The authors used radiators in the form of a piece of the coaxial line. The installation scheme for processing of fusions is shown in Fig. 2. The crucible 2 has to be the current conductor, for example, graphite. The nonconducting crucible is inserted into carrying-out screen.

The protective tube 3 separates the radiator from fusion and is made of quartz. It can't be used at low temperature of fusion. The radiator is made of copper or graphite.

There is no furnace in installation for processing of solutions. A glass flask is used instead of a crucible. The flask is wound outside by a copper foil. The solution sprayed by nozzles is influenced instead of solution in installation of flowing type.

Durability, plasticity and impact strength increase at the same time at the hardened metal after processing of NEMI of fusions of metals [1]. Sedimentation of salts of heavy metals is observed in water solutions [2].

2. The Experimental Studies

The recommendation: It is necessary to switch off electronic devices such as computers, control system of furnace, etc., which are located nearby before switching on the generator.

Experience 1: Radiation of diesel fuel was carried out in installation of flowing type. The generator with an amplitude of 7 kV and keyboard speed of 1 kHz was used. Speed of passage was 4 l/min.

The analysis of hydrocarbonic composition of the

*Corresponding author: Valeriy Vadimovich Krymskiy, professor, research field: electromagnetic effect on materials and water solutions. E-mail: krymskiivv@susu.ac.ru.

Fig. 1 Impulse form.

Fig. 2 Installation scheme: 1. furnace; 2. crucible with fusion; 3. protective tube; 4. radiator; 5. asbestos cover; 6. cable; 7. generator of impulses.

unirradiated and irradiated samples was carried out on the Hewlett-Packard 5892 II chromatograph. The maintenance of groups of hydrocarbons (C_{i-i+1} type) between vapors of paraffin hydrocarbons of a normal structure is presented in Tables 1-3. The content of paraffin hydrocarbons of a normal structure is presented in Tables 4-6.

The summary amount of “pluses” in the graph “change” in Table 1 makes 25.9%, the summary amount of “minuses” in the Table 2 is 20.68%. The summary amount of “pluses” in the graph “change” in Table 3 makes 6.3%, the summary amount of “minuses” in the Table 4 is 10.54%. Total amount of “pluses” in Tables 1 and 3 make 32.2%, “minuses” in Tables 2 and 4 make 31.22%. The close coincidence of percentage increase (32.2) and percentage reduction (31.22) of hydrocarbons composition takes place.

This count shows that there was a conversion of a chemical composition towards reduction of the content of hydrocarbons with the big content of carbon and increase of the content of hydrocarbons with the small content of carbon.

Table 1 Relative composition of hydrocarbons (%) for $<C_7 \dots C_{13-14}$.

	$<C_7$	C_{7-9}	C_{9-10}	C_{10-11}	C_{11-12}	C_{12-13}	C_{13-14}
Initial value	...	...	2.2	3.9	5.7	7.4	8.3
After radiation	0.5	3.6	6.2	11	12	11	9.1
Change	+ 0.5	+ 3.6	+ 4	+ 7.1	+ 6.3	+ 3.6	+ 0.8

Table 2 Relative composition of hydrocarbons (%) for $C_{14-15} \dots C_{18-19}$.

	C_{14-15}	C_{15-16}	C_{16-17}	C_{17-18}	C_{18-19}
Initial value	8.8	7.1	6.7	4.3	3.9
After radiation	7.8	4.9	3.3	1.4	0.92
Change	– 1	– 2.2	– 3.4	– 2.9	– 2.98

Table 3 Relative composition of hydrocarbons (%) for $C_{19-20} \dots C_{23-24}$.

	C_{19-20}	C_{20-21}	C_{21-22}	C_{22-23}	C_{23-24}
Initial value	3.7	2.7	1.8	1.0	0.54
After radiation	0.8	0.46	0.21	0.07	...
Change	– 2.9	– 2.24	– 1.59	– 0.93	– 0.54

Table 4 Relative composition of hydrocarbons (%) for $C_7 \dots C_{14}$.

	C_7	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}
Initial value	...	...	0.94	1.8	2.2	2.6	2.7
After radiation	0.21	0.83	2.7	3.7	3.4	3.0	2.7
Change	+ 0.21	+ 0.23	+ 1.76	+ 1.9	+ 1.2	+ 0.4	0

Table 5 Relative composition of hydrocarbons (%) for C₁₅ ... C₂₀.

	C ₁₅	C ₁₆	C ₁₇	C ₁₈	C ₁₉	C ₂₀
Initial value	3.4	2.7	4.4	3.8	2.1	1.5
After radiation	2.6	1.8	2.4	1.8	0.82	0.51
Change	-0.8	-0.9	-2.0	-2.0	-1.28	-0.99

Table 6 Relative composition of hydrocarbons (%) for C₂₁ ... C₂₆.

	C ₂₁	C ₂₂	C ₂₃	C ₂₄	C ₂₅	C ₂₆
Initial value	1.1	0.86	0.62	0.44	0.24	0.14
After radiation	0.32	0.23	0.14	0.09	0.05	...
Change	-0.78	-0.63	-0.48	-0.35	-0.19	-0.14

Experience 2: Radiation of Roze alloy (Pb, Bi, Sn). Alloy is standard. The composition of elements according to the passport (masses %) is the next: Pb-32.87; Bi-49.11; Sn-17.95; Sb-0.04; Cu-0.01; As-0.01; Fe-0.006.

Experimental conditions: The mass of an alloy is 0.5 kg, the crucible graphite Ø45 with internal dimensions, depth is 90 mm. Radiator is the copper rod Ø5 160 mm long in a quartz test tube of Ø10 mm. Alloy melting is made, stirring is carried out by a quartz stick and test taking of the initial test (No. 3) is carried out in a ceramic tank. Radiation of the melt was executed out of the furnace. Generator parameters: amplitude was 6 kV, frequency was 1 kHz. Time of radiation was 15 min. Initial temperature of radiation was 350 °C, finite -135 °C. Irradiated test was selected in a ceramic tank after melt agitation (test No. 4).

Sawdust was made from the received castings of tests 3 and 4 by a file. The analysis of a chemical composition of sawdust was carried out on the atomic and adsorption spectrophotometer "Quantum-2A". The atomic and adsorption spectrophotometer "Quantum-2A" was certified in the state system. The relative error of the analysis makes $\pm 2\%$, with confidential probability 0.95. Elements Bi, Cd, Sn, Sb, Cu, Zn, Fe are defined. The Pb element is defined as "remaining to 100%". Analysis results are presented in Table 7.

It is visible that good data fits on the initial test with passport data and good coincidence of balance of transmutation of elements takes place.

Experience 3: Radiation of an alloy of Pb, Bi. The alloy is prepared independently. Lead is granulated, composition in % masses: Pb-99.88, Sb-0.1, other Bi, Fe, Cu, Sn, Ag, As less than 0.06; Bismuth is granulated (composition: Bi-97.9, Pb-1.8, Ag-0.08, other Cu, Fe less than 0.001).

The hinge plate from Lead of 0.55 kg and Bismuth of 0.45 kg was used for preparation of the melt. The crucible is graphite Ø 55, height is 95 mm. Lead was heating to 400 °C, then Bismuth was added, stirring was made, a test taking of the initial test (No. 21) was carried out. Radiation of a melt was made out of the furnace. The radiator is the copper rod Ø 5, length is 120 mm in a quartz test tube of Ø 10 mm. Generator parameters: 6 kV, 1 kHz. Time of radiation is 15 min. Initial temperature is 400 °C, finite -250 °C. The irradiated test (No. 22) was molded after melt agitation.

The analysis of tests 21 and 22 in the form of sawdust was carried out on the atomic and adsorption spectrophotometer "Quantum-2A". Results are presented in Table 8.

It is visible that the composition of elements in the initial sample is very close to the value determined by the weight composition of 55% Pb and 45% Bi with the accounting of the additional composition of 1.8% of Lead in Bismuth. Transformation of 8% of Bismuth into Lead is watched after radiation. The rule of balance is observed.

Measurement of radioactivity of Lead and Bismuth in the form of sawdust in mass of 1 g was carried out on low-background installation of UMF-2000. Results

Table 7 Composition of elements, % masses.

Element	Pb	Bi	Sn	Sb
Initial, No. 3	32.3	50.0	17.5	0.2
Irradiated, No. 4	39.66	43.1	17.0	0.24
Change	+ 7.36	– 6.9	– 0.5	+ 0.04

Balance (amount of pluses and minuses): $-7.4 \rightarrow +7.4$.

Table 8 Composition of elements, % masses.

Element	Pb	Bi	Sn	Sb
Initial, No. 21	57	43.0	0.005	0.014
Irradiated, No. 22	65	35.0	0.006	0.014
Change	+ 8.0	– 8.0	+ 0.001	0

Balance: $-8 \rightarrow +8$.

of measurements are the next: exceeding of a α -radiation background for Lead – by 15 times, for Bismuth – by 7 times. Results of the measurements of activity for initial and irradiated tests are the next: exceeding of a α -radiation background for the initial test No. 21 by 6.25 times, for the irradiated test No. 22 – by 14.7 times. There was the significant increase in the α -radiation level of the irradiated sample after radiation. Measurements of radioactivity of these samples in the year gave background exceeding in the initial test by 5.6 times, in irradiated – by 3.6 times. Level change of β -radiation is in error limits.

Experience 4: Radiation of Roze alloy (Pb, Bi, Sn). The alloy was bought from the manufacturer. Experimental conditions: the mass of an alloy is 0.5 kg, the alundovy crucible with Ø55 internal dimensions, depth is 70 mm in the screen from a copper foil. Radiator is the copper rod Ø5, 160 mm long in a quartz test tube of Ø10 of mm. Heating of an alloy is made to 400 °C, stirring and a test taking of the initial test (No. 23) is carried out. Generator parameters are 6 kV, 1 kHz, time of radiation is 15 min. Initial temperature is 400 °C, finite –215 °C. Irradiated test (No. 24) was selected after stirring.

The analysis of tests 23 and 24 in the form of sawdust was carried out on the atomic and adsorption spectrophotometer “Quantum-2A”. Results are presented in Table 9.

It is visible that a large amount of Bismuth passed into Lead after radiation. Transition of small part of

Tin to Lead is also watched.

Results of radioactivity measurements of initial and irradiated tests are the next: exceeding of a α -radiation background for the initial test – by 115 times, for irradiated test – by 82 times. There was the considerable reduction of the α -radiation level of the irradiated sample after radiation. Measurements of radioactivity of these samples in the year gave background exceeding in the initial test by 35.6 times, in the irradiated by 29.6 times. Level change of β -radiation is in error limits.

Experience 5: Radiation of an alloy of Pb and Bi. The alloy is prepared independently. The chemical composition of Lead and Bismuth is given in Experience 3. The hinge plate from lead of 0.17 kg (39%) and Bismuth of 0.27 kg (61%) was used for melting. The crucible is graphite, Ø 45, height is 95 mm.

Heating of Lead was carried out to 400 °C, then bismuth was added, an exposure was carried out at a temperature 300 °C, stirring, a test taking of the initial test (No. 31). Radiation mode: the radiator is the graphite rod Ø6 of mm without protective tube, depth of dipping is 85 mm. Generator: amplitude is 10 kV, keyboard speed of 1 kHz. Time of processing is 10 min. Initial temperature is 260 °C, finite – 210 °C. Irradiated test (No. 32) was selected after agitation.

Researches of a chemical composition were conducted on the raster electronic microscope of JEOL JSM-6460LV firm (Japan) with system of

Table 9 Composition of Elements, % masses.

Element	Pb	Bi	Sn	Sb
Initial, No. 23	15.4	67.0	17.4	0.2
Irradiated, No. 24	28.26	55.1	16.4	0.24
Change	+ 12.86	– 11.9	– 1.0	+ 0.04

Balance: – 12.9→+ 12.9.

Table 10 Mean values of a chemical composition, % masses.

Element	Pb	Bi
Initial	30.34	69.66
Irradiated	41.96	58.04
Change	+ 11.62	– 11.62
Error	1.02	1.05

Balance: – 11.62→+ 11.62.

microanalysis JXFORD INCA EWC453 (Great Britain). Measurements were made on fresh cross cutoffs of samples. Three sites of 2×3 mm in size were researched in case of increase equal 30.

Distinctions on a chemical composition between the initial and irradiated samples by the results of mean values of three measurements are presented in Table 10.

It is visible that there is a considerable change of chemical composition that exceeds the measurement error by 11 times. The change balance of elements masses is observed: Bismuth turns into Lead.

Results of radioactivity measurements are the next: exceeding of α -radiation background for Lead–by 2.9 times, for Bismuth–background level. Results of activity measurements of initial and the irradiated tests are: exceeding of α -radiation background for the initial test is absent, for irradiated–by 3.6 times. There was an insignificant increase in the α -radiation level of the irradiated sample after radiation.

3. Analysis of Results

All our experiments were made by one technique. Melt agitation after preparation was carried out by a quartz stick and then a test “initial” was selected in a ceramic tank. It is known [4] that Lead in case of a melting temperature 327 °C has density of 10,678 kg/m³, and in a solid status–11,350 kg/m³. Bismuth in

a liquid status in case of a melting temperature 271 °C has density 10,050, and in solid–9,747 kg/m³, respectively. Therefore, density of lead will decrease and density of Bismuth will increase in case of extension a melt temperature above a melting temperature. It is possible that these densities will be close at melt temperatures of 350 °C–400 °C under which process of radiation begins and test “initial” is molded. The maximum error can be counted at the expense of a density difference for Lead density of 10,678 and 10,050 for Bismuth. If melt is not absolutely mixed, the density difference will make 628 kg/m³, this will make 5.9% in relation to Lead. Receiving of the initial test with the raised content of Bismuth is possible in case of insufficient agitation at the expense of density difference.

The place where test is molded is one more factor influencing on the quality of test. In our experiences tests were selected to the ceramic tank of $10 \times 10 \times 70$ mm in size. There is a melt crystallization in it.

The status chart of Bi-Pb alloy is used for the characteristic of crystallization process [5]. Crystallization of Lead-Bismuth alloys happens in the range of temperatures. Therefore a composition of the crystals which are forming at the beginning of solidification can significantly differ from composition of last straws of a crystallizing melt. The temperature interval of alloy crystallization is wider,

the segregation develops more strongly. The single alloy of Lead-Bismuth system crystallizing in case of continuous temperature (125 °C) is the alloy of the eutectic composition containing 56% (at.) Bi.

The following operation was carried out for the analysis of a chemical composition of samples “initial No. 31” and “irradiated No. 32”. Research of a transverse section of samples 31 and 32 in the direction from a sample bottom to its top in 8 areas was carried out by means of micro ray spectral analysis by a Carl Zeiss firm microscope. The area of measurement surface makes $\approx 0.5 \times 0.5$ mm. An exception method of results connected with casting boundaries – upper and lower is used when processing of analysis results of metal castings. Mean values on 6 layers are given in Table 11.

These values are 14% less than the data specified in Table 10.

All above mentioned results belonged to analyses of solid samples. The raster electron microscope allows to analyze the samples in the form of powders and sawdust. Sawdust from samples 31 and 32 in the cross direction was saw by a small-sized file for results comparison. This sawdust on a neutral glue basis was pasted on the end face of the rod Ø4 mm which was set in the analysis camera. The area of an analyzable surface made ≈ 10 mm². Data of the carried-out

analysis are given in Table 12. These data are very close to data given in Table 10.

An analysis of samples 31 and 32 was carried out also on the atomic and emissive spectrometer “Spektroflame Modula S” with the inductive and connected plasma. Hinge plate of an alloy of 0.22 g before the analysis dissolved in imperial vodka (HCl: HNO₃ = 3:1) in case of heating up. The hinge plate was received by shaving drilling by a drill with a diameter of 3 mm in the vertical direction of a sample. Solution was transferred to measured flasks after full dilution of a hinge plate and then measured volumes used for the analysis were taken. Concentration measurements were carried out with the use of standard components method. It was carried out in two measurements. Analysis data are presented in Table 13.

All data of the content measurement of Lead and Bismuth in samples 31 and 32 under different conditions of measurement are given together below for convenience of comparing (Table 14).

Data in Table 14 unambiguously specify the reduction of the Bismuth content and increase of the Lead content during radiation.

4. Theoretical Substantiations

The theory of electron capture is one of hypotheses

Table 11 Chemical composition of samples, % masses.

Element	Pb	Bi
Initial, No. 31	49.6	50.4
Irradiated, No. 32	59.6	40.1
Change	+ 10.0	– 10.3

Table 12 Chemical composition of samples 31 and 32 (sawdust), % masses.

Element	Pb	Bi
Initial, N0. 31	29.1	70.9
Irradiated, No. 32	40.97	59.3
Change	+ 11.87	– 11.6

Table 13 Average composition of elements, % masses.

Element	Pb	Bi
Initial, No. 31	34.5	65.65
Irradiated, No. 32	44.6	55.15
Change	+ 10.1	– 10.5

Table 14 Changes of the composition of Pb and Bi of samples 31 and 32, % masses.

Element	Pb	Bi	Analyzer
Metal, 3 platforms	+ 11.97	– 11.97	JEOL
Sawdust, 10 mm ²	+ 11.87	– 11.6	JEOL
Metal, 63 platforms	+ 10.0	– 10.3	Carl Zeiss
Shaving, 2 measurement	+ 10.1	– 10.5	Spektroflame Modula S

Table 15 Table of lead and bismuth isotopes.

Atomic weight	⁸² Pb		⁸³ Bi	
	Half-life period	Disintegration type	Half-life period	Disintegration type
204	1.4×10^{17} years, 1.4%	α	11 hours,	Electron capture
205	1.5×10^7 years	Electron capture, γ	15 days	Electron capture, β^+
206	Stable, 24.1%	...	6.2 days	Electron capture, γ
207	Stable, 22.1%	...	32.3 year	Electron capture, γ
208	Stable, 52.4%	...	3.7×10^5 years	Electron capture, γ
209	3.3 hours	β^-	1.9×10^{19} years, 100%	α , (3.1 keV)
210	22.3 years	β^- , γ	5.01 days	α , β^-
210m	...	...	3×10^6 years	α , β^- , γ

for theoretical reasons for transmutation of Bi→Pb under the influence of NEMI [3]. Change of atomic mass doesn't happen, and one of Bismuth protons becomes a neutron according to this theory. We will present a row of long-living isotopes of Lead and Bismuth [4] in Table 15.

The new result about an isotope ²⁰⁹Bi is received [6]. It is revealed its α -radiation with energy 3.13 keV and the half-life period of 1.9×10^{19} years is defined. The isotope ²⁰⁴Pb is specified as stable in literature. However it is specified as radioactive with a half-life period of 1.4×10^{17} years [7]. Existence α -activity of the initial and irradiated samples in Experiences 3, 4, 5 and its change within the time in Experiences 3 and 4 specify existence and change of the isotopic composition after NEMI radiation.

It is visible that if there are isotopes ^{210m}Bi, ²⁰⁸Bi and ²⁰⁷Bi in a melt before radiation, they can give a long-living isotope of Lead ²¹⁰Pb or stable isotopes ²⁰⁸Pb and ²⁰⁷Pb after NEMI radiation. The isotope ²⁰⁹Pb has small time of half-life. There would be the considerable change of analysis results during time in case of its existence. This effect wasn't watched. Unfortunately, we had no instruments for

measurement of the isotopic composition of Bismuth and Lead. Therefore it is necessary to consider the offered transitions ^{210m}Bi→²¹⁰Pb, ²⁰⁸Bi→²⁰⁸Pb and ²⁰⁷Bi→²⁰⁷Pb as a scientific hypothesis.

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