UNUSUAL STRUCTURES ON THE MATERIAL SURFACES IRRADIATED BY LOW ENERGY IONS.

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Some unusual structures on the surface of metals and films (various x-ray films and nuclear emulsions) caused by exposure to bombardment by low-energy ions in glow discharge plasma, in electrolysis and other low-energy processes (when energy of particles doesn't exceed several keV) have been found. The mechanism and model of the strange tracks formations and explanation of their structure change are suggested.

1 Introduction

For a number of years in various laboratories of the world physicists discover strange tracks (which we call traces, whereas the objects that cause them are termed as tracers) [1-5]. The traces, as a rule, are characterized by a microscopic width (usually about 10 micrometers), but their length is presumably unlimited (mm and more). Sometimes the traces look like a repeated pattern, similar to the tread design of a motorcar tire or a necklace (Fig.4). Sometimes the pattern forms a continuous line or a group of parallel lines, differing from the standard tracks left by heavy charged particles in nuclear photo-emulsions by their angularity or enormous length (up to cm). Occasional flaws of the samples containing traces (on the polished surface of metals or in photo-emulsions) do not explain the connected occurrence of the traces at the places of local energy generation: electrical discharges, particle accelerator targets, and the areas of natural disasters or technogenic ones, which are caused by the human activity). This feature of the phenomenon in question may be used to predict or to avoid the technogenic disasters, for example, the search of traces or tracers can help in analyzing the causes of the Chernobyl Catastrophe.

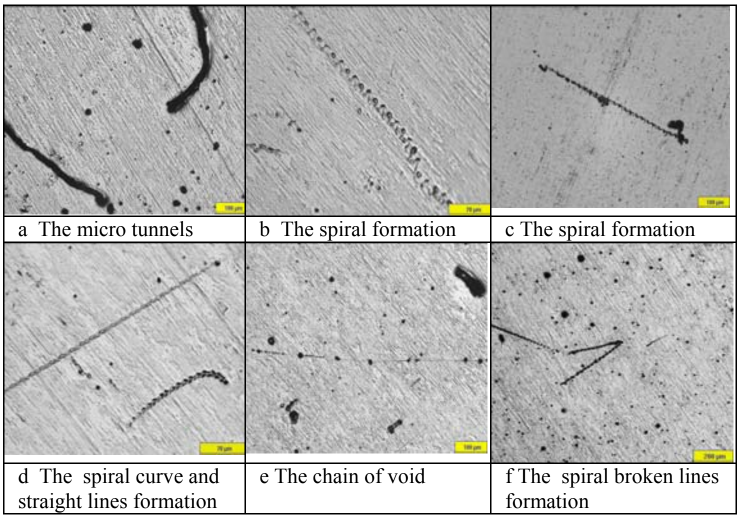
2. Experimental results and discussion.

We observed the unusual structures on the surfaces of metals after glow discharge exposure (Fig.1) and on the films (various X-ray films, nuclear emulsions and others), placed both on the inside and the outside of the glow discharge chamber (Fig.2). The similar tracks formations (with periodical repeating structure) were found on the nuclear emulsion films after the neutron generator exposure (Fig. 3). Such tracks structures as demonstrated in Fig.1-3 (regular structures, spirals, chains, chains of voids and others) need the comprehensible explanation from the viewpoint of material science and demand special physical interpretation.

However, the classical approach to the study of physical phenomena requires not only substantiation of the principal possibility of the process in question, but also its detailed description including illustrative examples. The latter may become possible on the basis of a model of filiform (threadlike, filament) matter, i.e. fluxes. Some components of the 'flux theory' will be discussed below in application to the problem under discussion.

Along with traces (in metals to the depth of 1-2 cm), changes in physical and chemical properties of underlying layers from the viewpoint of their composition and structure are observed (see Table for Fig 4). Under the surface of previously monolithic sample some micro-tunnels and "holes" appear (Fig. 1-4). On the surface of the samples examined before the exposure without any distinctive properties, not only traces, but also some microscopic structures – films, hollow spheres and cylinders, threads, spirals, complex spherical and cylindrical formations looking like "cabbages" or "sausages"- were discovered after the exposure to low-energetic electrons, ions or ultrasound action (Fig.1-4). Sometimes these structures remind bacteria or a colony of bacteria, which may glow (fluoresce) in the dark. These objects move randomly and appear on the surface or "plunge" back into the depth of the previously monolithic material. This activity of "live" bacteria objects may continue for weeks after the energetic influence (after it has been finished) [4].

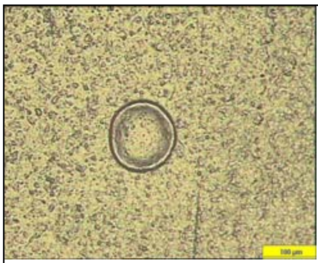
Each of these objects is unusual in the shape, surface structure and the chemical composition. The chemical composition in these formations is sharply distinguished from the composition of the basic material on which these formations had arisen (tables to Fig. 4 with chemical composition). We shall take into account that all these objects have been obtained under conditions of low-energy particles influence when the nuclear processes in materials from the traditional point of view couldn't exist. Therefore at present there is no comprehensible hypothesis for the formation of such structures from the impurities. We shall also take into account, that the majority of the chemical elements forming unusual structures were not present in the initial material, and in the composition of the surrounding medium or in constructive details of the experimental installations.



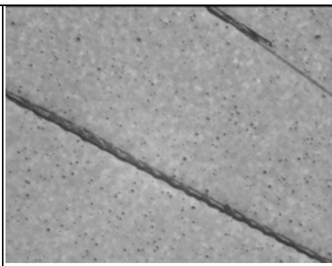
a The micro tunnels; b The spiral formation; c The spiral formation; d The spiral curve and straight lines formation; e The chain of void; f The spiral broken lines formation

Fig.1. Tracks on Pd surface after deuterium glow discharge exposure (optical microscope. a, b, d, e, f – Pd surface after deuterium bombardment, c – back side; a, c, and e- 100µm; b and d -70µm, f - 100 (200 µm)

Thus, the shape, structure and composition of unusual objects demands special explanation, probably, based on new physical concept. This unusual concept, as well as their possible practical application requires further examination of unusual structures.

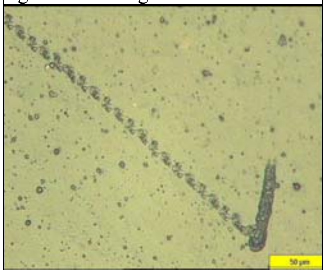


a) “Melting “bubble” on X-ray film (RT-2 type) after deuterium glow discharge with Pd.

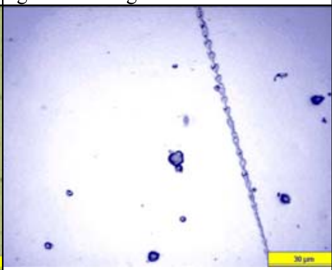


b) The parallel tracks on X-ray film (Kodak Bio Max) after deuterium glow discharge with W-W cathodes.

c) “Cylindroid” (like “sausage”) on the nuclear emulsion after deuterium glow discharge with W-W cathodes.



d) Spiral structure on X-ray film (RT-2 type) after deuterium glow discharge with Pd.



e) The spiral with “conic” step on X-ray film (Kodak Bio Max) after deuterium glow discharge with Zr.

Fig.2 The structure on the films placed outside of the glow discharge chamber with stainless steel wall (a, d) and quartz walls (b, c, e) after deuterium glow discharge with Pd (a, d), and with Zr (e), with W (b, c).

Marks sides on Fig.2 are following: a), b), c), and e) are 100 μm; d) - 50 μm

a)

b)

Fig.3 The periodical structure track on the nuclear emulsion after neutron generator exposure (b – three-rays “star” (→) is the results of fast neutron interaction with carbon nuclei with 3 alpha particle formation: $^{12}C + n \rightarrow 3\alpha + n$).

3. Explanation and possible mechanism

We can offer two approaches to the explanation of the formation of such unusual structures: integrated and differential approaches.

3.1. *The integrated approach.* In the view of long-range action concept in which development Feynman R.P., Yu.S.Vladimirov and others participated in the second half of 20th century, formation of the complex objects, capable of leaving observable traces with complex structures - TRACERS - can occur instantly and at once [6-9].

As from experimental researches in the end of 20th century, the traditional concept of philosophical reductionism (occurrence of big object from small parts) in many cases showed physically insolvent.

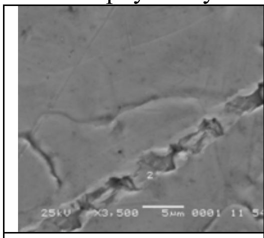


Fig.4.1. Mark is 5μm

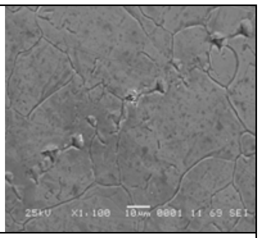


Fig.4.2. Mark is 10μm

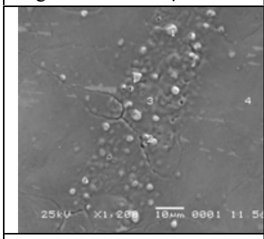


Fig.4.3. Mark is 10 μm

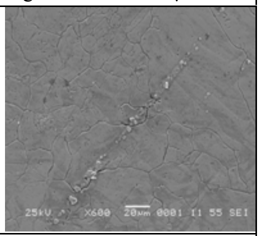


Fig.4.4. Mark is 20μm

The analyzed place	Element	Atomic %
Fig.4.3 Point 1	Mg	2.43±0.17
	Fe	8.39±0.26
	Ga	2.48±0.39
	Pd	86.70±0.48
Fig.4.2 Point 2	O	54.36±1.64
	Mg	3.92±0.32
	Ca	2.73±0.28
	Pd	38.98±1.61
Fig.4. 3 Point 2	O	10.20±0.69
	Al	3.71±0.17
	Fe	4.75±0.26
	Ga	2.72±0.36
	Pd	78.61±0.79
Fig.4.4 Point 1	Fe	11.32±0.27
	Ga	1.43±0.47
	Pd	87.25±0.52

Fig.4. The structure formations (traces) on the Pd surface after deuterium glow discharge.

The vivid example of this is the detection of fractional quantum effect of Hall (the Nobel Prize of 1998) and his theoretical interpretation by Robert Laughlin [10].

The observable fractional charge of current carriers in semiconductors appears as a result of the certain condition of all semiconductors. Self-similarity as direct consequence of long-range action explains any transformations of substance as quantum transitions in the Universe.

So, occurrence of observable forms of life in the Universe or complex structures of unusual chemical compound (such as TRACERS) on surface of electrodes bombarded by ions are the next state of the Universe. Self-similarity of objects of the Universe could explain the process, but does not allow considering the dynamics of such quantum transitions.

3.2. *The differential approach.* It is based on stage-by-stage formation of complex objects from more simple ones and allows considering dynamics of transitions from simple to complex.

This second approach from reductionism position is traditional methodology, but, as against the first approach, in our case it does not allow "to skip" through the basic difficulties. The possibility of "cold" transmutation of atomic nucleus is not simple to explain from this position. We suggest overcoming these difficulties on the basis of consideration of a new hypothetical filamentary structure of matter.

The basis of using such extravagant assumption is the astrophysical data on presence in cosmos of the so-called dark matter which makes the most part of mass of the Universe.

The dark matter can have filamentary structure. If diameter of filament is closed to the diameter of atomic nucleus, they will easily pass through any dense substance of usual nuclear-molecular structure (through any solids, planets or stars).

In the author's model such filaments – *fluxes* - can be cylindrical atoms. The nucleus of such a cylindrical atom can represent a quark - gluon filament stabilized by quanta of magnetic flux, and an electronic shell - an electronic Bose-liquid with properties of super fluidity and superconductivity. The diameter of flux electronic shell according to calculations is ~ 60 f [11].

Fluxes can create an invisible grid, which wrap round not only far Cosmos, but also all our planet, penetrating all bodies (solids) existing on the Earth (including us with you) and influencing them in the various ways. Interaction of invisible fluxes with usual nuclear-molecular substance could be in the various ways [11, 12].

The huge gradient of a magnetic field promotes an attraction to magnetic poles of particles with nonzero magnetic dipole moment (electrons, protons, neutrons, many atomic nucleus, atoms and molecules, ions) which can enter in nuclear interaction.

Elementary calculation shows that frequency of nuclear processes on magnetic poles of hypothetical filaments – fluxes should reach $10^{14\ -15}$ s^{-1}, which enables evolution of an output power of 100 W. The approximate, rough estimation (rough guess) is given below.

Assuming the magnetic moment μ of the shell of paramagnetic atom (molecule, ion with radius $\approx 10^{-8}$ cm) to be of Bohr magneton and equivalent magnetic charge of the flux end (magnetic pole) to be minimal Dirac's magnetic charge $e_m \approx 70$ e (e is electron charge), one can estimate magnetic attracting force of the atomic particle to the flux end, $F = 2\mu e_m/a^3 \approx 10^{-3}$ dyne, and the time of flight of the captured atomic particle with mass of $\sim 10^{-23}$ g to the flux end to be about 10^{-14}s. This magnetic attraction determines the "self-aiming" of the atomic nucleus to the flux end. Besides, if the flux end is situated inside or on the surface of the dense (solid or liquid) paramagnetic matter, there may happen up to $\mathbf{A} \cdot 10^{14}$ nuclear interactions per second, where **A** is the mass number of the captured nucleus. At the nuclear distance, $r_N \approx 10^{-12}$ cm, the attracting force of the nuclear particle with a magnetic moment μ_N nearly equal to the nuclear magneton ($\mu/\mu_N \sim 2000$) to the flux end (magnetic pole) is $F_N = 2\mu_N e_m/r^3_N \sim 5 \cdot 10^5$ dyne and the magnetic energy of one nucleon capture is $F_N r_N \sim 1$ MeV or A MeV per one captured nucleus (atom). For A ~ 10 this corresponds to the power of approximately 100 W.

Nuclear reactions can also go on lateral surface of fluxes in an electronic Bose-liquid, which shields the electric charges of nuclei [11]. In the end, plenty atomic nuclei in the usual nuclear-molecular substance forming lengthways ensembles of fluxes quanta with the cross sizes about 100 microns [13, 14] can interact simultaneously. Thus, the problem of cold nuclear fusion and nuclear transmutations in the fluxes model is authorized by three ways: transformation of atomic nuclei on magnetic poles – ends of fluxes, in electronic liquid on a lateral surface fluxes and in multinuclear reactions in associates of fluxes nuclear ensembles.

Due to non-conservation of spatial parity in e-capture in the powerful magnetic field of fluxes, the main flow of arising neutrino is directed against the force lines of a magnetic flow. As the result of e-capture the filaments of neutrino at the northern magnetic pole create jet traction which pulls the filament after North Pole (like a locomotive pulling its cars). At the southern magnetic pole force of reaction of neutrino pushes (compresses) the filament, because of which unstable movement of South Pole of the filament is possible.

Due to output power of capacity during the nucleus transmutations, a part of "new" nucleus is formed on fluxes, in particular, nucleus with zero spin and, hence, with zero magnetic dipole moment. They should scatter, forming a "hot" shell of these "new" nuclei near fluxes filament which are inside dense nuclear-molecular substance. Due to melting and evaporation of nuclear-molecular substance with its subsequent condensation on cold parts of the sample, nuclear active fluxes leave their complex structured traces both on the surface and inside samples in which they are formed (Fig.1). The nuclear active fluxes or complex fluxes object (we name such an object TRACER) can move along trace (trajectory) in the substance.

The filamentary tracer of the structure can leave the trace without moving at all or moving, for example, in the perpendicular direction to a line. In Figure 5_t the presumed mechanism of formation of the various-shaped tracers is shown. The atom-molecular quantum ensembles surrounding fluxes (the grey colored cylinder in Fig. 5_t) push out the fluxes (the white colored cylinder) to the periphery of the ensemble where the temperature of ensemble substance is lower, the density of atoms is higher and probability of polynuclear reactions is the highest, too (Fig. 5_t b). Such pushing-out results in bending of flux and atomic-molecular ensemble surrounding it and interacting with it (Fig. 5_t c). In turn, the bend of ensemble with fluxes can lead to turning the ensemble with fluxes into a ring or a spiral (Fig. 5_t d, e).

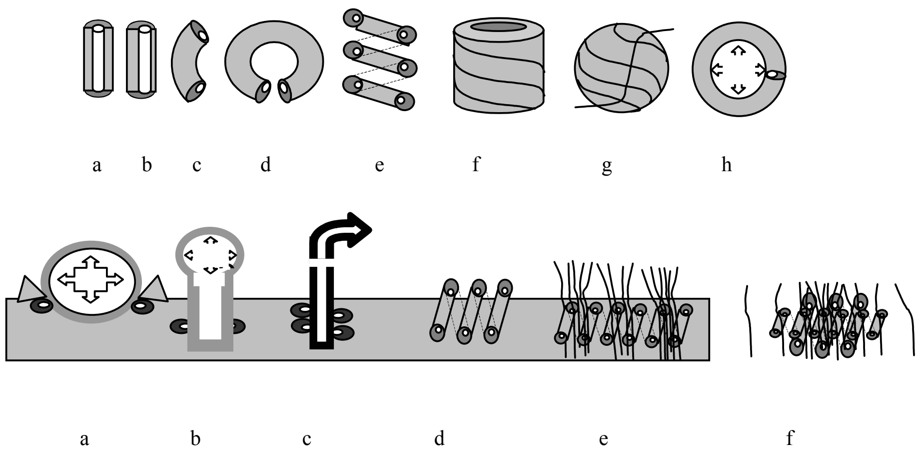


Fig. 5. Flux model of strange tracks formation (5_a – top row of Fig.5, 5_b- bottom row of Fig.5)

Let's note that sometimes geologists found out such spirals of microscopic sizes, for example, of refractory tungsten inside various compact samples (in rock) in reality.
Geologist Elena Matveeva found tungsten spirals inside 200000 year-aged rock (Fig. 6). Formation of more complicated bodies of cylindrical or spherical symmetry during warming-up by nuclear reactions (Fig. 5_b f, g) is also possible. The formation of hollow cylinders and spheres is possible as a result of oozed gases in chemical and nuclear reactions in environmental substance around fluxes (Fig. 5_b h). Sometimes it is possible that such elementary processes create hollow quasi sphere particles ("blobs") and extensive hollow "cylindroids" on surfaces of a metal sample (Fig. 5_b a, b, c). "Blobs" and "cylindroids" can be broken off on the surface (or near surface) of the sample by

internal pressure of gases contained in them, leaving in the local zones of metal surface the melt films formed near nuclear active fluxes. Helicoid atom-molecular shells of nuclear active fluxes in projection to the flat surface of sample frequently give the sine "paths"- "trajectory" with changed composition of the basic material (traces in Fig. 5_b). From known mathematical Fourier's theorem it follows that the sum of sinusoids (or cosinusoids) with different amplitude and period can give a track of any shape, the geometrical pattern repeating periodically. Such kind of double spiral object we found on the X-ray film, exposed outside of glow discharge chamber after deuterium experiment (Fig. 2d).[2]

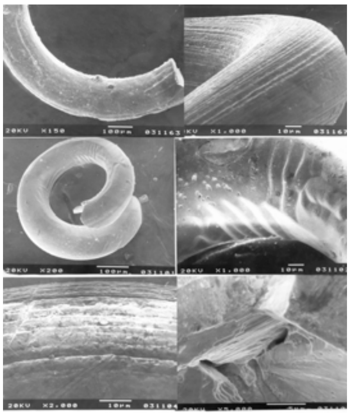


Fig.6.The tungsten spirals 200 000 year-aged inside the bore pit rock was found by geologist E. Matveeva.

In our opinion, the origin of mysterious periodic patterns (chains and more complex trajectories, Fig. 1-4) on the surface of the samples (Fig. 5_b d, e, and f) can be explained by such kind of processes. Thus, concentration of the fluxes earlier not participating in the process of nuclear interaction with substance (Fig. 5_b e and f), but activated by electromagnetic and nuclear processes in various places of trace is possible.

This secondary interaction of the fluxes can considerably complicate the trace figure. Especially the composite figure can arise from the cooperative action (combined effect) of several nuclear active fluxes which form, for example, enclosed spirals (Fig. 5_b f), and from activation of earlier passive secondary (tertiary) fluxes, transiting through a trace.

Conclusion

We hope that further investigations of these unusual strange formations on the surfaces of various materials subjected to various low-energy exposures, will allow establishing the true mechanism of unusual structures formation. Applied prospects of such examinations will naturally be defined by physics of probable unusual processes the examples of which we have considered.

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