

APPROACH OF ADVANCED NANO-TECHNOLOGIES' "ARMAGEDDON" Sapogin V. G., Sapogin K.V.

By manufacturing transistors with less than 5 nm dimensions the advanced nano-technologies of China have faced the problem of transistors' explosion. In the paper physical causes of approaching "Armageddon" are investigated. It occurs due to insufficient knowledge of manufacturing engineers in distribution of alternating current across the conductor.

The investigation executed below shows that at gigahertz frequencies the rectilinear current of cylindrical conductor with diameter less than 20 nm is expelled from the conductor to the surface due to known skin effect. The expulsion of current to outside is so strong that inside the current the cylindrical cavity with lack of charges is formed.

The electrons that expulse to the surface of conductor are not scattered under effect of Coulomb force but form charge cluster of exterior shell with very thin wall. The cluster with similar charges is held in the wall by pressure of electric self-field so as the hot plasma is held by pressure of magnetic field under thermonuclear fusion. The equality of current pressure and field pressure is resulted in explosion at sudden change of conductor's resistivity on p-n junction.

Approaching "ARMAGEDDON" of nano-technologies will help to solve the problem of creation of new engineering devices. They will operate on Ampere-Foucault ring-currents with radius of 0,1 nm or less one. Sub-nano-computers and engineering devices with the lowermost energetic consumption can be realized at the base of these technologies.

At the site: <https://3dnews.ru/988458> the paper of Г.Детинича «Китайские учёные разработали 3-нм транзистор» (G. Detinich "The Chinese scientists have developed 3-nm transistor" in Russian) has been published. There the author has explored the problems with these Chinese breakthrough technologies have faced on creation of transistors with the dimensions less than 5nm.

In this paper one of the important problems is mentioned among others – ***transistors of small dimensions begin to explode***. The researchers explain these explosions by deterioration of heat exchange between transistor and substrate. The event they called Boltzmann Tyranny. In our opinion, it explains the problem heart only partially.

It seems that physical reasons of "Armageddon" arisen are more serious and deep. The few people know how the alternating current has been distributed in cross-section of conductor and how it flows inside. The Ohm's law illuminates the phenomenon from one side only.

Any current, flowing in metal, is the flow of charged particles with similar signs, coming from the source. On the one hand the Coulomb force acts between them. On the other hand, unidirectional currents attract each other due to Ampere force. The moving charges will also interact with the fields of crystal lattice and with self-field. The interaction has to be essentially depended on the amplitude, frequency of the flowing current, conductor's diameter and its resistivity.

The solution of assigned problem is described by the system of Maxwell's equations, supplemented by Ohm's differential law. The solution of the system of equations in the planar case is well-known. You can see it in the books of I. Eug. Tamm "Foundation of electric theory" [1], (in Russian) and A. N. Matveev "Electricity and magnetism" [2], (in Russian).

As a matter of fact, theorists have found only one solution for the planar heterogeneous alternating electric field. The solution obtained by them does not belong to complete set of even functions of system. But nevertheless, this finding permits them to base “skin-effect” – new physical phenomenon, i.e., expulsion of alternating current to the surface of conductor.

The profound investigation has shown that in planar case the system of equations has the complete set of solutions, composed of 4 even functions. The solutions are based on the total pressure integral, consisted of current pressure and electric field pressure, which interact themselves. The three of them describe skin-effect (expulsion of current to the surface). But the fourth one – the effect of current’s layer crowding, which can also occur at high frequencies.

So, it is possible to have not one, but four versions of alternating current cross-section’s distributions, as it has been considered earlier. When there is an equality of pressures of currents and field, the current can be expelled inside the conductor. The original solutions have been obtained in the monograph [3].

In cylindrical symmetry there also are three solutions as minimum, which describe diverse versions of cross-section’s current distribution. There is the version of pinch, compressed near the system’s axis, which the theorists have not seen. This phenomenon has been discovered in 2001 during experiments of American researchers Kuhn and Ibrahim. They named it *Current Crowding Effect* [4].

The further investigation of total set of solutions for axial current in cylindrical symmetry has shown that the most interesting “wonders” occur at the flowing of currents in diameters less than 20 nm. ***There one wondering phenomenon occurs, but meanwhile the modern applied-physics specialists don’t know about it.***

The rectilinear current of cylindrical conductor with diameter of 20 nm and less one, is expelled from conductor to the surface due to known skin-effect at the frequency of GHz order. But in this case current’s expulsion to the surface is so strong that inside the current the cylindrical cavity with lack of charges is formed.

The electrons, expelled to the surface of conductor, are not scattered under effect of Coulomb force but form the charge cluster of exterior shell with very thin wall. The cluster is held by pressure gradient of electric self-field [5] so as the hot plasma is held by the pressure of magnetic field under thermonuclear fusion.

The tubular cluster of charges is similar to “stranglehold” and does not permit electrons to leave the surface of conductor. But as soon as sudden change of resistivity arises at p-n junction or n-p junction the equilibrium state of current’s pressure and field’s pressure is resulted in explosion.

The conductor can explode also on lack of p-n junction. Recently this phenomenon has been experimentally examined by full professor M. Marakhtanov <https://m.nkj.ru/archive/articles/4072/>.

The current has been transmitted through metal films with thickness of some hundreds atomic layers. The temperature of cooling metal has been fixed. It has been about 180°C. At values of current density more than $1,43 \cdot 10^9$ A/m² in tungsten and $8,04 \cdot 10^9$ A/m² in aluminum, conductors have exploded during microseconds.

The fundamental physical law discovered explains why the conductors, supplying the transistor with current, will explode. The huge forces, coupled with pressure gradient of electric field, disrupt the crystal lattice of conductor. The conductors with diameters of nanometers will explode always. The decrease of current density in conductors only prolong the time of “ARMAGEDON”. This decrease will result in that the current amplitude will be insufficiently to change electric state of p-n junction.

The explosive instability of thin conductor will stop at the previous positions the technology, whereas the billions dollars have been invested in its development!!! It is impossible to remove the explosive instability of conductor! But it can be outwitted. Let's discuss a new hypothesis.

According to hypothesis promoted, the deadlock, arisen in nano-domain of conductor, can generate a new direction of investigation in sub-nano-domain of the same conductor.

The real chance to begin promotion of technologies into sub-nano-domain of conductor appears now. It is possible to excite **ring-currents of Ampere-Foucault** in conductor by alternating magnetic field. The physical consequences of Maxwell-Ohm's equations for azimuthal current component in conducting film are supported by experiments. The current's radii can be on the order less than 1 nm.

It is need to understand the physics of process clearly. Only then one can definitely move forward. Nobody explains to us that all magnets, created by humankind, in fact, represent superconducting state of ring-currents of Ampere-Foucault at indoor temperature.

The currents of such radii don't emanate any heat energy. The electrons, moving along the ring, stop the collision with positive ions of conductor, being in heat motion. They rotate as atom's electrons in vacuum. The lifetime of ring-currents is more than 100 years (but it may be infinity!).

The calculations show that ring-currents of Ampere-Foucault have resistivity from 10^{-15} to 10^{-20} ohm-m (copper 16 nohm m). The ring-currents open the drastic region of engineering and physical investigations of humankind – the region of high-temperature superconductivity (HTSC) of conductor. Only ring-currents can have HTSC. The rectangular currents also have HTSC but only under ultralow

temperature at the small-scale lengths. And ring-currents will preserve superconductivity even under the temperature of metal fusion!

Litskalnen – the Latvian, who has escaped to Argentina in 1917, has left after his death the real garden, decorated with large-tonnage stone pillars. How did he move them? Until now the architects “break their heads” over this question. But 100 years ago Litskalnen has played with steel plates, adhering to each other. He has magnetized the plates by rectangular conductor with the current from accumulator. We suppose that the phenomenon of high-temperature superconductivity has been discovered in these experiments for the first time and has been exploited by Litskalnen in practice.

We tested the simple experiments of Litskalnen. Two separate steel plates by the square of $10 \times 15 \text{ cm}^2$ and with thickness of 1 cm have been attracted to each other with estimating pressure of 1 MPa. It occurred after transmission of current pulse of 500 A along the conductor inside the plates. The attractive force was 15000 N. Nobody could separate them by hands during two years.

See the photograph of experiment at fig.1.



Figure 1. The magnetized plates of Litskalnen in experiments of A. Atamanchenko and D. Dzyuba (Taganrog, 2018-2020)

The data about these experiments in wide scientific community's range has not been observed. Although in network reels the boys hang on these magnetized steel plates by all their weight. And claim experiments of Litskalnen as their own one. Really, such children of genius! Ukrainian blogger Andrew has heated the plates to incandescence. And just the same he couldn't separate them from each other. But there is No Curie point (magnetic transition temperature)!!! And radiation resistance is probably such that nobody can imagine.

One needs to understand how these currents can be excited in nano dimensions without application of p-n junction. The Faraday's law of electromagnetic induction permits to realize it. One can create new manufacturing classes of memory cells and switching elements of very arbitrary configurations at any conductors (for example, at the steel film, which manifests magnetic properties). They will substitute p-n junctions that have worked for a century.

Let's take a conductor with diameter of 10 nm and place the steel film near it or place this conductor into the film. The current pulse has passed. The vortex electric field has rotated currents of Ampere-Foucault in the film. The currents don't consume electric power. The film waits for centuries, while you will read off this data from it. The data is following: does film create magnetic field or no? It is similar to the past memory unit (cube) at the ring ferrites. The data has been read off either by forward current or by reverse one. And again the film waits the signal, being recorded. It is binary cell. The signal is present here or not.

Approaching "ARMAGEDON" of high nano-technologies will help to solve the problem of creation of devices, operating at the ring-currents of Ampere-Foucault with radii of 0,1 nm and less one. Sub-nano computers and engineering devices with the lowermost consumption of electric energy can be realized at these currents.

We express the sincere appreciation to our colleagues, Anatolij Atamanchenko and Dmitriij Dzyuba, carried out the experimental investigations of attraction's effect of Ampere-Foucault's ring-currents.

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