Resonance transfer of neutron - model and experimental precondition

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We began our investigations dealing with low energy nuclear reaction (LENR) soon after the first publication by M. Fleischmann and S. Pons in 1989 [1]. Our studies are based on an assumption that this phenomenon can occur in a matrix of metals characterized by high deuterium absorbability. This assumption is confirmed by a number of experiments such as electrolysis of deuterated water, saturation from a gas phase [2] and others. In this case the chemical composition and structure of the deuterium saturated material exert an essential influence on mechanisms of LENR. We are convinced that the intrinsic properties of a metallic matrix are responsible not only for the ability of a material to accumulate deuterium but also for the possibility of deuterons to move and interact.

It is well known that in metals hydrogen isotopes can interact with not only the idle lattice but also crystal lattice defects such as dislocations, vacancies, etc. [3,4]. The generation and movement of crystal lattice defects occur in the process of plastic deformation. That is why in our early experiments we studied deformation of samples saturated by deuterium. The titanium alloy VT9 was used for investigations. Two batches of VT9 alloy samples were studied. The first batch samples have the structure with a size of primary β grains 500±100 μm, α plate thickness of 6±1 μm and the amount of β phase about 20%. Deuterium saturation of these samples did not lead to any significant changes in the structure, except the growth of the amount of β phase up to 50%. The microstructure of the second batch samples was characterized by the absence of α plates at matrix β grain boundaries. Its α plates were bent and their thickness did not exceed 1±0.1 μm.

The experiments revealed the occurrence of electromagnetic emission in the range of radio frequencies and the formation of tritium only in samples with a definite structure [5]. Besides, the compression force for samples from batch 1 and 2 with different structures differed by twice, though all other conditions (concentration of deuterium, temperature, and sample dimensions data) were similar. The emission was detected only in the second batch samples preliminarily subjected to heat processing to form coarse-grained structure. This resulted also in an increase of the strain load in the first stage of deformation.

The procedure of saturation by deuterium has similar difficulties connected with repeatability of experimental results too. The final treatment of titanium alloy samples before their saturation consisted of annealing at the temperature T = 1200^0 C for grain coarsening and plastic deformation by bending. The electromagnetic radiation within the range of radio frequencies was registered in the samples subjected to such treatment in the process of their deuterium saturation from a gas phase [5]. These examples show an importance of preliminary structure processing for repeatability of LENR results.

Reasoning from the experimental results identified one can conclude that mechanisms of LENR undoubtedly depend on the structure of a material. The vast studies of the interaction of hydrogen isotopes with metals are conditioned by the essential influence of hydrogen on mechanical and physical properties of metals and alloys [3,6]. Many of them are devoted to interaction of deuterons with crystal lattice defects. Our model of the mechanism of interaction of deuterons in metals is based on the interaction of deuterons with crystal lattice defects.

Now let us consider the mechanism of LENR occurrence in a solid body via transfer of neutron from deuteron. We proposed this mechanism for describing the processes of tritium and helium formation as well as transmutation of elements [8]. The mechanisms comprises formation of pairs of ions (D_2^+), (DT^+) and (DA^+) at crystal lattice defects since in the idle lattice the formation of such pairs is not possible because of space limitations. The transfer of neutrons is induced by an accelerating movement of pairs of ions along a long-measuring crystal lattice defect of a metal matrix.

The interaction of pairs of ions (**D+D**) and (**D+T**), occurring via resonance transfer of the neutron from one deuteron to another, results in formation of proton (^{1}p) and tritium nucleus (^{3}T):

$$^{2}D + ^{2}D = ^{3}T + ^{1}p \qquad (1)$$

or from the deuteron to tritium results in formation of ^{1}p and helium nucleus (^{4}He) [6]:

$$^{2}D + ^{3}T = ^{4}H + ^{1}p \rightarrow ^{4}He + ^{1}p + e^{-} \qquad (2)$$

As DA^+ moves along the defect with an optimal size, vibrations are initiated in the ion and at definite resonance frequency the neutron from the deuteron starts to undergo the effect of nuclear forces from nucleus ^{m}A. As a result, new nucleus ^{m+1}A are formed:

$$^{2}D + ^{m}A = ^{1}p + ^{m+1}A \qquad (3).$$

The occurrence of reactions (1), (2), (3) is impossible without an accelerated movement of ions along crystal lattice defects of a metallic matrix. It can be realized only in the surface layer because only the location of one end of a long-measuring defect on the surface can provide conditions under which ion pairs can escape from the metal with acceleration under the effect of internal stresses.

The process occurs locally in respect to the plane normal to the axis of a crystal lattice defect.

The mechanism proposed can be confirmed by the following:

1. The measurement of tritium after deformation of titanium alloys [5] showed that formation of tritium occurred only on the surface layer of samples.
2. A local character of the process is confirmed by extremely small area dimensions where "unexpected elements" are formed [9]. Moreover, the phenomenon of nuclear active environment (NAE) which existence is discussed in literature also testifies to the local character of LENR processes.
3. The theoretical substantiation of reaction (1) was given in the manuscript by J. Schwinger [10].

References

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