Innovative Approach

STRUCTURAL CHANGES OF SINGLE CRYSTALS IN NEUTRON GENERATION EXPERIMENTS

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Abstract
This paper presents the results of new analysis of X-ray data (crystal lattice parameters and elementary cell volumes) both before and after experiments. On the basis of detection of structural changes, it is reasonable to suggest that the generation of neutrons occurs at the instant of disruption of channel structure of solid, associated with compression of crystal lattice. Perhaps the processes of explosive character inside the crystal, caused structure rebuilding, take place. Such changes may be considered as phase transition.

1. Introduction
Single crystal samples are capable to become perspective materials for cold fusion. Different experiments on reproducibility and search for neutron generation using single crystals of oxide tungsten bronze were run in the last years [1-5]. However, some experiences have not produced the positive result. This can be associated with failure to meet necessary requirements relative to preparation of experiment. Our numerous experiments with the use of two-ring detector and electronics in CAMAC-standard [4] have shown, that some events were registered to be considered as separate neutron bursts of duration of some tens of microseconds. We have shown [5], that neutron generation is observed with such crystals, which had sufficient perfection of the working plane in the beginning of the experiment. During experiment as well as at preparation for it, the perfection of crystals is subject to distortion, resulting in a disappearrance of effect.

2. Method
In this paper we propose a latest analysis of X-ray studies of single crystals of oxide bronzes. X-ray pattern of the samples was performed by DRON-3 diffractometer under Cu-k_α radiation (with the use of Ni-filter). The IBM computer processes from recorder X-ray data simultaneously concerning refinement of diffraction maxima position, analysis of phase composition, as well as information on parameters of crystal lattice and errors of their definition.

The primary objective is to investigate the structural changes of single crystals of oxide tungsten bronzes with cubic structure which are involved in neutron generation experiments. We used crystals grown by the electrolysis of molten salts. We carried out experiments using only crystals free from admixtures (polytungstates, tungsten etc.) on the surface.

Filming of X-ray patterns has been conducted from the same planes of crystal, just as before conduction of experiments, so also after them. This has allowed to record changes in a surface layer of the sample. In these experiments both positive results on registration of neutron events, and negative results were observed.

The neutron yield was found to be at most consistently 2-3 times above the maximally observable significance of background level (background was observed during two days

before experience). Registration of neutrons was conducted with the use of the two-ring detector containing 15 counters of SNMO type in each ring.

3. Results and discussion

Results of account of X-ray patterns of the Na_xWO_3 samples, when positive effect has been observed, are presented in table 1, and results in the case that positive effect was not found, are tabulated in table 2 . Here a_1 and a_2 are the respective parameters of the cubic lattice before and after experience, V_1 and V_2 are the respective volumes of the elementary cell before and after experience, X_1 and X_2 are the respective contents of the alkaline metal (Na) in surface layer of the crystal before and after experience, V/V_1 is the relative change of the volume of elementary cell during experience.

The quantities X_1 and X_2 are calculated with use of the known relation, connecting the parameter of the crystal lattice with the content of the alkaline metal (Na) in the bronze

$$a = 0.0819\,X + 3.7846\ (Å). \qquad (1)$$

Table 1

a_1(Å)	V_1 (Å^3)	a_2 (Å)	V_2 (Å^3)	X_1 / X_2	V/V_1 (%)
3.8539	57.24	3.8460	56.89	0.85/0.75	0.61
3.8546	57.27	3.8494	57.04	0.85/0.79	0.40
3.8526	57.18	3.8430	56.76	0.83/0.71	0.73

Table 2

a_1(Å)	V_1 (Å^3)	a_2 (Å)	V_2 (Å^3)	X_1 / X_2	V/V_1 (%)
3.8534	57.22	3.8532	52.21	0.84/0.84	0
3.8508	57.10	3.8509	57.11	0.81/0.81. ..	0
3.8587	57.45	3.8596	57.49	0.90/0.91	0.07
3.8526	57.18	3.8567	57.37	0.83/0.88	0.33

Trough the analysis of successful experiments it is possible to conclude, that elementary cell volume of the samples used in these experiments has been decreased. All the samples, for

which neutron effect was not found, were imperfect (with microblocks and strong tension). For them a decreasing of elementary cell volume was not found (within the limits of the error of definition dV = 0.02 $Å^3$), or this volume was increased.

The repeated use of the sample, the growth regime and the operations on its preparation can result in significant disorder of perfection and, as a consequence, in absence of neutrons emission and in nonreproducibility of the results. In particular, the generation of neutrons was found to be sensitive to water steam atmosphere. By a method of X-ray analysis we established, that in such atmosphere a disorder of crystal structure perfection of the single crystal surface takes place. This is due to the fact that the water molecules in a surface layer form hidrogen bonds with atoms (ions) of oxygen-tungsten octahedrons deforming them, and accordingly, deforming a channel structure formed by these octahedrons as a whole. Besides, the water steam can exert some influence on process of the nuclear reactions with neutrons, as the solid substence is in this case saturated not only with molecules of deuterium, but also with complexes HD and hydrogen molecules as well.

This clearly demonstrares the direct influence of insignificant (at first sight) conditions on reproducibility of results and the complexity of conduction of correct electrochemical experiments on cold fusion.

In this connection it must be note, that preliminary electrolysis pursued before experience for the purpose of creation of the channel structure in surface layers of single crystal, while is, as appear, a necessary procedure, can at the same time in itself bring into local reduction of elementary cell volume. This is thermodynamically due to the fact that under electrochemical extraction of sodium the defect in the centre of elementary cell of the Na_xWO_3 crystals will be formed. The regimes of electrolysis should thus be chosen with the special attention.

As appear, the degree of depletion of alkaline metal inside sample remainsto be optimum. On the one hand, at electrolysis it is necessary to extract from the bronze enough quantity of sodium for formation of channels absorbing atoms or molecules of deuterium. Thus the character of conductivity of surface layers depending on the content of alkaline metal can vary. On the other hand, the premature deformation of the lattice and structure violation involved in the composition change and in the their related change of bronze properties, should not hinder realization of processes, resulting in neutron generation.

A question remains to be answered, which factors cause significant reduction of elementary cell volume of those crystals which bring into existence the positive results during experience.

Based on conducted researches, we propose that the generation of neutrons occurs at the moment of distortion of the channel structure of substance, connected with compression of crystal lattice. Perhaps, the processes of explosive character inside the crystal, caused the structure rebuilding, take place. Such changes may be considered as phase transition.

References

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