Reproducible Nuclear Reactions during Interaction of Deuterium with Oxide Tungsten Bronze

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ABSTRACT

The possibility of essential increase of rate of carring out nuclear reactions with participance of deuterium in solids representing solid electrolytes with cation-electronic conductivity has been shown in the paper. It is found out that strict maintenance of experiment parameters leads to completely qualitatively reproduced results: generation of neutrons and heat at introduction of deuterium into the system.

1. Introduction

Begining with the famous work of Fleischmann and Pons on cold fusion /1/ the investigators of anomalous nuclear phenomena in condensed matter did not succeed in getting 100 % reproduction of the results on observation of emission of nuclear reactions products. All these experiments were carried out with solids on the basis of systems metal-hydrogen, neither the structure nor crystallographic orientation being non controlled. Unlike all other experiments carried out earlier for achieving of high level of reproduction we used principally new materials as investigation objects: monocrystals of oxide tungsten bronzes (OTB) of non stoichiometric compounds, having general formula Na_xWO_3. The facet (100) of the crystal was a working surface and the channels of rigid W-O sublattice being perpendicular to it. Alkali metal cations are placed and can move in these channels. In dependence on the content of alkali metal in OTB in consequence of change of valent state

FRONTIERS OF COLD FUSION

of tungsten in sublattice W-O, electronic conductivity of OTB can very greatly. It allows to create structures with high gradients of composition and properties conditioned by it.

2. Methods

Natrium may be extracted from channels in surface layer of bronze crystal and replaced by hydrogen ions by electrochemical methods (anodic treatment in salt melts, water solutions or vacuum).

The main part of experimental installation is a hermetic chamber of stainless steel. Anode and cathode consisted of tungsten plates situated one over another are inserted into the chamber. Monocrystal of natrium tungsten bronze of $Na_{0.9}WO_3$ composition in the form of a plate 10 x 10 x 2 mm in size was placed on anode. The plate was cut out of monocrystal grown by electrolysis of polytungsten melt according to the technique worked out by us /2/ in such a way that natural facet (100) was a working surface. At mounting of the installation the gap of 2 mm between the working surface of crystal and cathode was kept.

The measurement of neutrons flow were taken by means of 2 independent channels: 2 blocks of 4 counters of SNM-42 type with paraffine retardant. These blocks were placed at both sides of the chamber, their signals being summed by digital recorder and were led out independently at the register tape. Summary efficiency of 2 blocks was about 1.4 %.

Crystal temperature was measured by chromel-alumel thermocouple made of wires 0.1 mm in diameter.

After placing the crystal on the surface of anode the chamber was hermetized and evacuated up to 10^{-6}-10^{-5} mm Hg. After that anode with the crystal was heated up to 720-760 °C and direct voltage 500-1000 V was switched on between anode and cathode and passing current was registered. Such anodic treatment lasted for 1-5 hours and suumary amount of electric charge was 0.1-1.0 C. After switching off current the crystal was cooled to room temperature and deuterium (or hydrogen) was introduced into the chamber till the pressure becomes 1 mm Hg. The introduction moment considered as a zero point of counting and was registered at the tapes of registration of neutrons flow and temperature. Restarting of digital neutron recorder was being produced at the same moment. In 10 minutes the chamber was vacuumed once more and registration of neutron flow and crystal temperature was going on.

Then the cycle was repeated. Up to 15 cycles were carried out at one crystal.

3. Results

Neutron flow intensity after deuterium introduction increase sharply and in 10-20 min registration does not exceed the background (fig. 1).

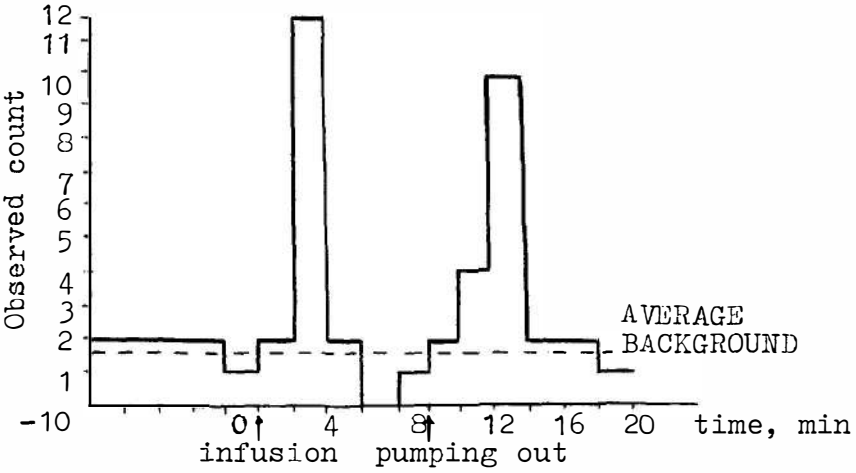

Figure 1. Typical observed neutron production

Always one can choose 2 minute interval during the first 5 min, when average intencity of neutron flow essentially in several times exceeds the background.

Just the same neutron impulse but with less intensity is observed after begining of pumping out.

Thus, for example, in one of the last series of 4 experiments with one and the same monocrystal (total) number of exceeded 100 those with positive results) average neutron emission was fixed during 2 min $(800 \pm 300)n$ at infusion and pumping out (650 ± 300) n at ratio of signal to the background 8 and 6 correspondingly. In one of control experiments the flow $(3.6 \pm 1.3) \cdot 10^4$ N/min was fixed. In the experiments with hydrogen excess of neutron flow over the background was not uncovered.

The increase of crystal temperature takes place synchronically with introduction both hydrogen and deuterium. The front of temperature increase for deuterium is more steep, temperature jump (Δ T) varies in great limits, reacing sometimes 40-50 °C for deuterium. In the series of experiments at one and the same crystal, in which after deuterium infusion in repeated cycle

hydrogen infusion, was conducted, it was determined that temperature jump for deuterium is higher than that for hydrogen.

4. Discussion

The main result of the work is getting out to the level of qualitative reproduction of experiment, when performance successivness of operations with monocrystal of OTB described earlier leads to one and the same reply at predicted up to 1 min time: generation of neutrons and heat in the experiments with deuterium and neutron generation stops 10-20 min later. Thus single action causes the effect happenning only once.

If to suggest that the reaction generating neutrons occurs at the expense of deuterium, absorbed by the channels of crystal at introduction, that all current at anodic treatment is spent for natrium extraction and the number of deuterium atoms N, absorbed by the crystal is equal to the number of extracted natriun atoms (at passing of 1 C of electricity 0)

$$N = \frac{Q \cdot N_A}{F} \approx \frac{1(C) \cdot 6 \cdot 10^{23} \ (at/mol)}{96500 \ (C/mol)} \approx 6 \cdot 10^{18} \ D \text{ atoms},$$

(F - Faraday of electricity, N_A - Avogadro's number), thus the average neutron emission rate per deuteron pair (DD) at infusion

$$\Lambda = \frac{400/60 \ (n/s)}{3 \cdot 10^{18} \ (DD)} \approx 2 \cdot 10^{-18} \ n \ (S)^{-1} \cdot (DD)^{-1}.$$

5. Conclusions

The results of the work allow to come to a new level of experiment: determination of qualitative dependences between the process parameters, that will give the opportunity to find out the mechanism of the phenomenon observed and to discover the ways of realization of controlled process.

6. References

1. Fleischmann, M. and Pons, S., 1989, Electroanal. Chem.,261, 301.
2. Kaliev, K.A. and Baraboshkin, A.N., 1982, In: Oxide Bronzes.Moscow, 137.