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Research Article

Stimulated ($B^{11}p$) LENR and Emission of Nuclear Particles in Hydroborates in the Region of Phase Transfer Point

Vladimir I.Vysotskii*

Kiev National Shevchenko University, 64/13, Volodymyrska Street, City of Kyiv, Kiev 01601, Ukraine

Alla A. Kornilova, Vladimir S. Chernysh,
Nadezhda D. Gavrilova and Alexander M. Lotonov

Lomonosov Moscow State University, GSP-1, Leninskie Gory, Moscow 119991, Russian Federation

Abstract

In this work, we consider the characteristics of proton (hydrogen) processes that take place in a special class of crystals (hydroborates), linked to the task of isolating and separating hydrogen and nuclear fusion with the participation of hydrogen. Preliminary results on observation of stimulated $B^{11} + p = He^4 + \Delta E$ reaction in hydroborates are presented.

Keywords: LENR, Hydroborates, Nuclear fusion

1. Introduction

The search of optimal systems for effective implementation of low energy nuclear fusion (LENR) is one of most important problems in this field. One of the most interesting systems for this is hydroborates. Interest in hydroborates is connected to the large quantity of hydrogen bonds and water molecules in these structures. In the process of heating crystals, the hydrogen bonds break and it is possible to release molecular water and also a large number of protons in the process of decomposition. Such processes have been observed in natural borates, from room temperature up to the temperature of full break-down of the crystal.

Practically, hydroborates can be donors of free hydrogen just as metal are donors of free electrons. The typical concentration of protons in hydroborates is about $n_p \approx 10^{22}$ cm^{-3}. One more reason for the big interest in hydroborates in connected to how their composition ideally corresponds to the precondition for producing the synthesis reaction with the formation of helium nuclei. One more doubtless advantage of hydroborates is the following – they are stable natural

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*E-mail: vivysotskii@gmail.com

materials and contained in a giant quantity in earth's crust. These crystals may play an essential role in natural power of the Earth and may be one of the essential sources of natural thermal energy!

2. Physical and Electrodynamical Properties of Reality of Hydroborates

The general scheme of the behavior of hydroborate gratings during phase transfer come down to the following stages:

- The loss of absorbed water and water, filling the pores in the crystal (this process is observed during the heating of crystals up to 100°C – 120°C).
- Transformation of part of the OH^- of the group in H_2O.
- Decay of H_2O and its connection to borate anions and then "exiting" the framework of all the water.

As a result of a process of dehydration, a change takes place in the structure: a less hydrated structure forms as a result of the loss of crystallized water. In these processes, a large quantity forms of quasi-free hydrogen in the grating (strong proton conductivity appears).

In the course of doing this work the following research was conducted.

- **Differential scanning calometry (DSC)** is a method used for registering heat flow, which characterizes the changes taking place in a substance as a result of heating or cooling. The sample and the standard are both heated or cooled at identical speeds, and their temperatures are kept the same. Experimental curves show the dependence of heat flow on temperature.
- **Thermo-gravimetric analysis (TGA)** is a method of thermal analysis which registers the change of sample mass depending on temperature.
- Gaseous products are analyzed with **Fourier infrared spectroscopy (FIRS)**.
- Researching the **dielectric and conducting properties** of hydroborates.

The results of conducted investigation of physical properties of different hydroborates are presented in Figs. 1–4.

For single crystals of colemanite a temperature–frequency dependence was obtained for dielectric permittivity. The analysis of this dependence leads to the following conclusions.

Practically all types of natural hydroborates show phase transfer and sporadic changes of conductivity, which is connected with the remolding of the structure of the crystals. The temperature of these phase transfer lies at a very low interval. For example, in *colemanite* the phase transfer corresponds to the temperature of 0°C; or in *interboride*, at 40°C and 100°C; and in Ulexite, at 40°C and 80°C. These anomalies are observed only at very low frequencies (indicating proton conductivity!).

3. Preliminary Research into Processes of Stimulated Nuclear Fusion in Hydroborates in the Neighborhood of Phase Transfer Point

The dependencies, obtained above, which determine the properties of hydroborates all over the interval of temperatures and frequencies under study, enable us to pose a question about the possibility of producing nuclear fusion in such crystals. We base this statement about the experiment on the following. It is well known that one of the most attractive nuclear reactions

$$\mathrm{B}^{11} + \mathrm{p} = \mathrm{He}^4 + \Delta E \tag{1}$$

is characterized by a large release of energy $\Delta E = 8.7$ MeV and by the nearly complete absence of induced radioactivity. In ordinary conditions of a paired collision of free nuclei, this reaction has a maximal cross-section under relative energy

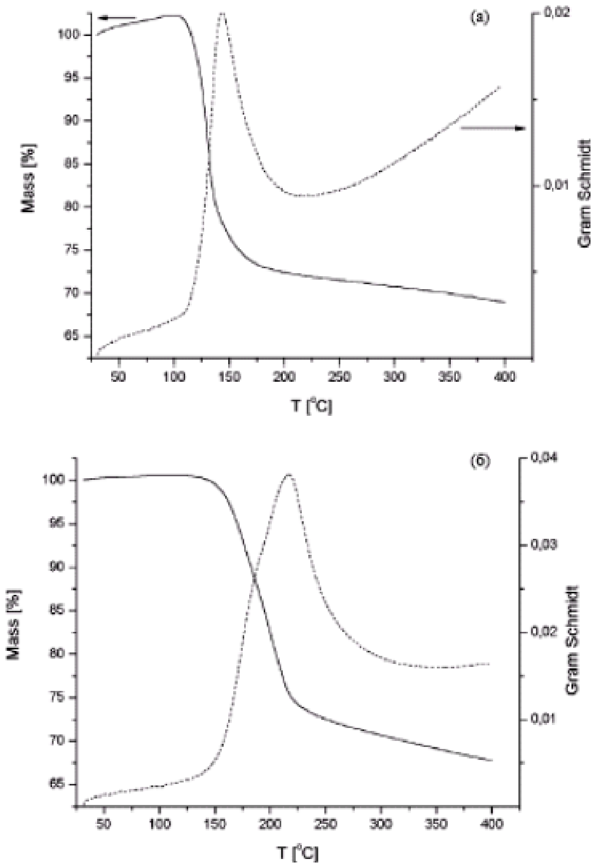

Figure 1. TGA (Thermo-gravimetric analysis) analysis for ***interboride*** (top) and ***ulexite*** (bottom).

of colliding particles$T_{\mathrm{pB}^{11}} = 675\,\mathrm{keV}$. This is large energy and usually, to obtain it, highly precise ionic accelerators are needed.

However, in cases when the interacting particles are located in non-stationary microcavities and in the volume of non-standard crystals (crystals which are in the stage of transition processes like phase transfer) the fusion process may occur even at low energy of relative motion. Such processes were observed in, for example, deutereted crystals like KDP crystal during phase transfer, when the local deformation of crystalline grating led to a stable and recurrent generation of a small number of neutrons by the formula

$$\mathrm{d} + \mathrm{d} = \mathrm{He}^3 + \mathrm{n} \tag{2}$$

In the hydroborate crystals under consideration there are all the prerequisites for realizing the reaction for the synthesis of He^4(1)(quasi-free hydrogen in a state with large mobility; the boron ions, representing local targets and variable local conditions (the presence of phase transfers and local high pressure).

The presence of phase transfers at different temperatures is very important and may be used for safe auto-control of LENR with negative temperature feedback. Practically all types of natural hydroborates show phase transfer and

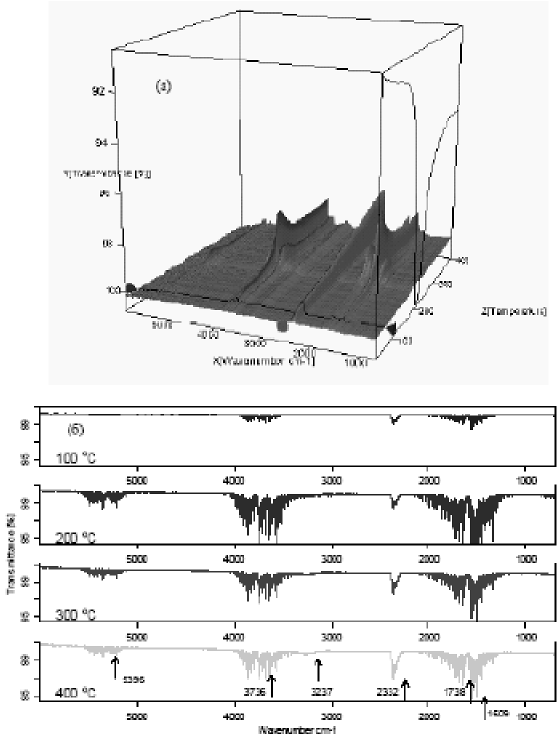

Figure 2. IR absorption for ***interboride***.

spasmodic change of conductivity, which is connected with the re-moulding of the structure of crystals.

The mechanism of suppression of the Coulomb barrier to nuclear reactions in such crystals is, most probably, connected with the process of formation of correlated states in continuously changing potentials holes during phase transfer [1–3].

The temperature of these phase transfers occurs at very low temperature change. For example, in *colemanite* the phase transfer corresponds to the temperature of 0°C; in *interboride* at 40°C and 100°C; in *ulexite* at 40°C and 80°C. These anomalies are observed only at very low frequencies. This is the result of proton conductivity in hydroborate crystals! For convenience, the research conducted is adduced below with the use of more "burning" phase transfer for which it is necessary to heat the sample of hydroborate to temperatures exceeding 100°C. At the beginning of this cycle of measurements a calibration of the measuring device was done. In Fig. 5 the calibration spectrum is presented for an alpha-particle source of the isotope Pu^{239} with maximal energy of about5.2 MeV.

The unit of scale division was calculated by formula $5.2\,\mathrm{MeV}/N_{\max}$. The initial experiments on controlled $(\mathrm{B}^{11}\mathrm{p})$LENR were conducted in the following way. A fresh single crystal of hydroborate was placed directly on an alpha-particle sensor. To heat the local temperature to the point of phase transfer, the sample was touched by the tip of a soldering iron. To eliminate interference, the soldering iron was first heated, and then unplugged from the electric power mains. On heating the samples, a light crackling noise was heard. The samples at the point of contact with the heater became opaque and turned a milky white color. These phenomena are explained by how in the process of gradient heating used in our experiments, internal tensions arise in the crystal followed by cracking of the samples. For

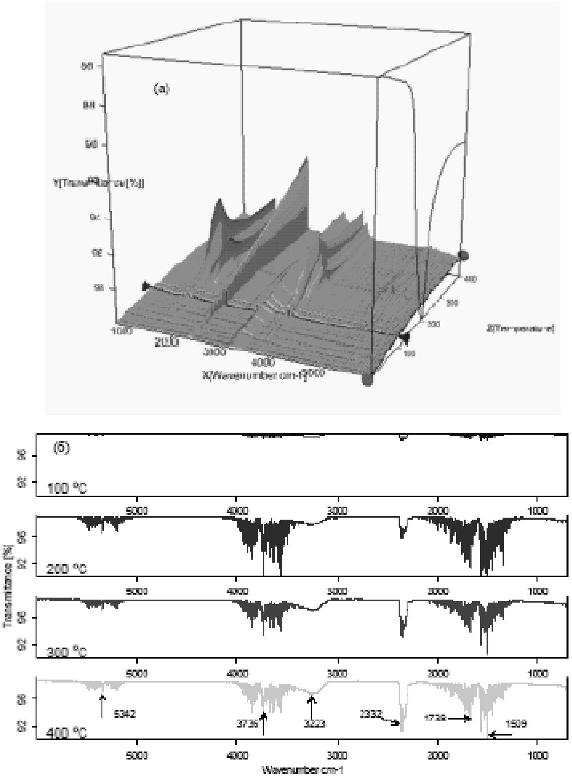

Figure 3. IR absorption for ***ulexite*** .

each sample, several trials were conducted. For each separate measurement a fresh crystal was used.

In Fig. 6, the data from measurements of alpha-particles emission from different crystals of hydroborates are presented.

For the *ulexite* crystal (Fig. 6, top) in the course of 10 s a signal was observed in the region of 200–210 channels on the lower scale. The signals in the neighborhood of the 60th channel are a hindrance which can be eliminated by weakening the sensitivity of the amplifier. The calculation by the above formula gives, for channels 200–210, a value of energy particles of about 60.6 keV. That emission of particles, which was observed in the course of the initial phase of heating, testifies to how nuclear transformation occurs during phase transfer caused by heating.

In Fig. 6 (bottom), experimental results are given for *inderborite* crystal. Together with the parasitic noise signal lower than the 50th channel, there are also individual pulses in the region of channels 100–130. These signals were detected in the first ten seconds after the start of heating. The calculated value of energy turns out to be 29.5 keV in the neighborhood of the 125th channel.

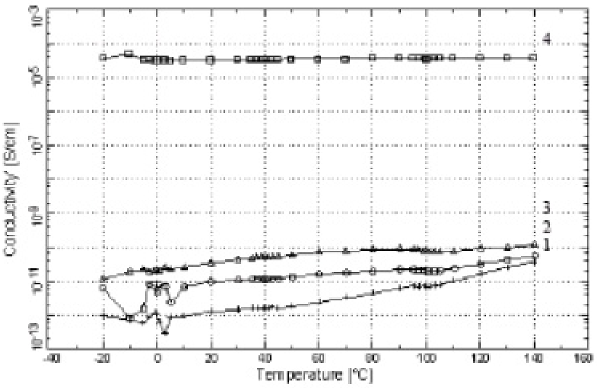

Figure 4. Temperature dependence of conductivity of ***colemanite*** at frequencies of 1-0,1; 2-1;3-10;4-10-7 Hz .

4. Summary

The adduced data indicate how in the crystal of hydroborates, nuclear reactions of synthesis can take place. Of course, the preliminary results do not enable one to conclude that these reactions are effective. Also unknown is the spatial location deep within the crystal, where the fusion conditions are fulfilled. Obviously, these reactions occurred at a relatively great depth, which led to the low energy of the emitted alpha-particles.

We plan to conduct these investigations with controlled contactless heating of the sample with step-by step research throughout the whole temperature range. In the course of carrying out this work, we also considered methods and perspectives on fusion in synthetic borates.

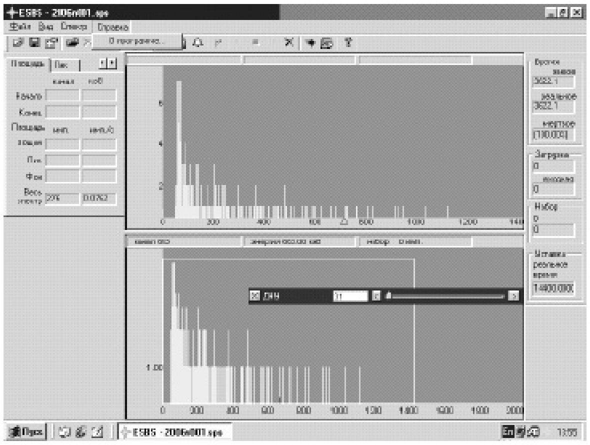

Figure 5. Calibration spectrum of alpha-particles source with the use of isotope Pu^{239}.

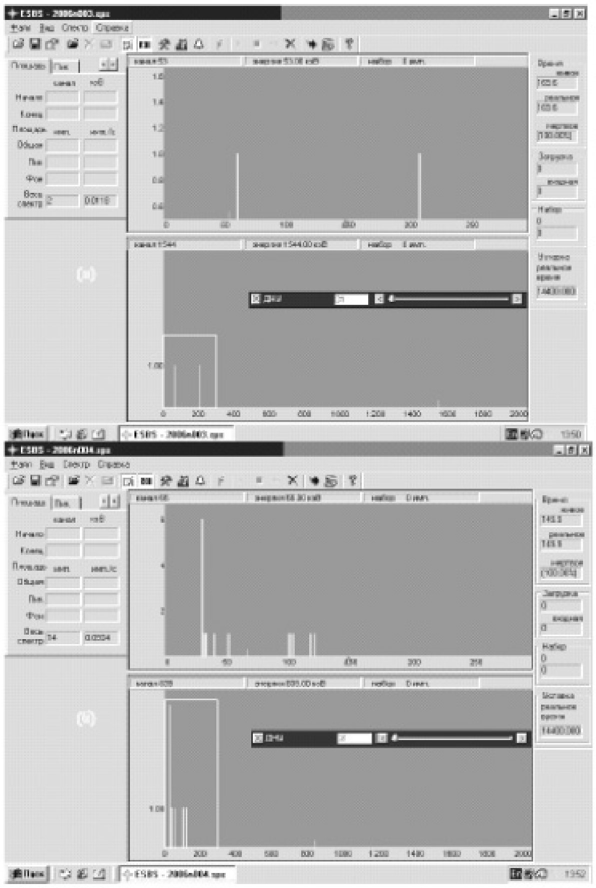

Figure 6. Registration of alpha-particles, flying out in the course of a local heating from crystals of ***ulexite*** (top) and ***inderborate*** (bottom).

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