Cold fusion: superfluidity of deuterons.

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The nature of cold fusion (CF) is considered. It is supposed that the reaction of deuterons merger takes place due to one deuteron, participating in the superfluidity motion, and one deuterons, not participating in the superfluidity motion, participate in the reaction. The Coulomb barrier is overcomed due to the kinetic energy of the Bose-condensate motion is very large. The Bose-condensate forms from delocalized deuterons with taking into account that the effective mass of delocalized deuterons is smaller than the free deuterons mass.

The effective mass of deuterons must satisfy the condition

$$m^* < 1.5\frac{\hbar^2}{kT_0}n^{2/3} \ , \qquad (1)$$

where n is the concentration of the delocalized deuterons, T_0 is the temperature of the Bose-condensate. Using the values $T_0 = 300\ K$, $n = 10^{22}sm^{-3}$, obtain the estimation

$$m^* < 2 \cdot 10^{-26}g \approx 0.006\, m_d \qquad (2)$$

The Bose-condensate moves in the magnetic field with the speed v_{si}, defined by ratio

$$en_s v_{si}(\mathbf{r}) = -\int Q_{ik}(\mathbf{r}-\mathbf{r}')A_k(\mathbf{r}')d^3r', \qquad (3)$$

where n_s is the concentration of particles of the Bose-condensate, $A_k(\boldsymbol{r})$ is the vector potential of the electromagnetic field. The function $Q_{ik}(\boldsymbol{r})$ is defined from microscopic analyze of the motion of the Bose-condensate. The motion of the Bose-condensate is considered in the framework of the London's electrodynamics. This approximation allows obtain the linear on the field term in the expression for the power, exuding in the reaction. Exuding in the cylindrical form sample power is equal to

$$W = 2\pi r_d^2 \frac{B_0 c}{e} h r_0 P_0 n_d E_0 \qquad (4)$$

Here r_d –the deuteron radius, B_0 – the value of vector $\boldsymbol{B}$ of the external magnetic field, c –the speed of light, e- the electron charge, h -the high of the cylinder, r_0 –the square of the bottom of the cylinder, P_0 – the probability of reaction with collision of two deuterons, n_d – the concentration of deuterons in the lattice, E_0 – output of the energy in one nuclear reaction.

We obtaine the estimation $W \sim 10^9\ erg/s$ for the sample with $h = 10\ sm$, $r_0 = 1\ sm$, in the field $B_0 \approx 0.5\ Gs$ under $n_d \sim 10^{23}$ см$^{-3}$, $P_0 \sim 10^{-5}$. This estimation is coincided with the experimental data [1] by the order.

It can be understood why mainly occur the reactions

$$B_d + d + d \rightarrow {}^4He + B_d' + 23.8\ \text{MeV}$$

Here B_d and B_d' are the states of the Bose-condensate before and after the collision of one deuteron, belonging to the Bose-condensate, and one deuteron, not belonging to the Bose-condensate. Gamma-quantum does not stand out in the reaction (5) due to the large amount of particles of the Bose-condensate change their velocities. The momentum and the energy under the reaction condition conserve due to this fact.

It can be understood why the CF-reactions occur in palladium and titanium only. This fact is connected with the effective masses of delocalized deuterons in palladium and titanium are small.

[1] E.Storms "Status of cold fusion (2010)", Naturwissenschaften, vol. 97,no. 10, pp. 861-881, 2010.