INFINITE ENERGY™

The Magazine of New Energy Technology

New Energy • New Science • New Technology

Volume 8 • Issue 46 • 2002

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Comparison Between Two Theoretical Models for Deuteron-Plasmon Interaction with Enhanced Tunneling Effect

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Abstract

This paper presents a theoretical analysis of the possible effects that different concentrations of impurities contained in the lattice can have on the phenomenon of fusion catalyzed by deuterons. The numerical calculation, performed for Ni, Pd, and Pt at fixed lattice temperature, as a function of the degree of impurity at 0.28% and 0.72%, shows that the probability of penetrating the Coulomb barrier increases with increasing impurity. This result can be interpreted considering the trend of the potential describing the effective interaction between deuterons within the metal; this in effect shows that the coupling between plasmons and deuterons, in the presence of impurities, is not only able to reduce the thickness but also lower the height of the Coulomb barrier *K* in various types of deuterium-loaded lattice. Further, we consider the influence of the temperature on the phenomenon of deuteron fusion within metal lattices with CFC or HC structure, hypothesizing that a kind of chain reaction, catalyzed by microcracks—which form in the structure as a result of variations in the thermodynamic conditions or for other reasons—can promote the process. From the numerical simulation performed for different metals (Pd, Pt, and Ti), varying the temperature and the total energy, it is possible to conclude that the probability of interaction is in effect notably enhanced by increasing these parameters.

In fact, studying the curves of the interaction potential between deuterons (including the deuteron-plasmon contribution) in the case of three typical metals (Pd, Pt, and Ti), in a three-dimensional model, it was found that the height of the Coulomb barrier decreases on varying the total energy and the concentration of impurities present in the metal itself.

In this model, at fixed lattice temperature, the contribution from deuteron pulsation does not evidence a thermodynamic-type effect. In fact, the equilibrium lattice temperature is much lower than that corresponding to the energy of the deuterons; on the other hand, if the deuteron energy is increased, the height of the Coulomb barrier decreases, thereby determining a large increase in the probability of fusion.

In the present paper, we intend to study any possible influence that variations in temperature may have on the phenomenon, since this could favor the fusion of deuterium nuclei as a result of deformations or microcracks produced in the lattice. These could have the effect of concentrating in their vicinity a relevant fraction of the deuterons present in the metal.

The phenomenon hypothesized should possess characteristics analogous to the formation of Cottrell atmosphere in metals, well-known in solid state physics, which essentially consists of a redistribution of the impurities present in a metal around a dislocation of the ions making up the lattice.

In these cases, the interaction between the impurities