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On cathodically polarized Pd/D systems

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Abstract

Excess energy in "cold fusion" with hydrogen and deuterium can be interpreted in terms of magnetic interactions. The corresponding new "tight" Bohr orbits explain new properties associated with this energy production

A well-known (but widely discussed) experiment of Fleischmann and Pons [1] has shown excess heat energy production attributed to some presently unknown "cold fusion" process. Its possible future implications have stimulated a new line of research. Recent experiments have confirmed the reality and reproducibility of this excess, based on different experimental setups such as electrolysis of H_2O [2] and D_2O with Pd or Zn electrodes, electric discharges in gas, plasma discharges [3] or sonoluminescence.

It appears now as a fact (1) that if some experiments have confirmed the appearance of small quantities of possible "fusion ashes" (such as neutrons H4 and various nuclear isotopes (not originally present)) they cannot (by many orders of magnitude) explain the observed heat excess in H_2O or D_2O based experiments: even more so in H_2O or the experiments (2) that except for a few observed strong neutron bursts (and γ bursts) the "ash" mainly consists of soft X-rays in all known low-energy input experiments.

The field of interpretation thus is now circumscribed on the theoretical and experimental levels.

The aim of the present comment is to stress the theoretical importance and implications of Ref. [4] by Szpak et al. for future interpretations and to suggest further experiments along the same line, i.e. to look for X- and γ-emission in cathodically polarized Pd/D systems.

Its theoretical importance lies in the observation of a new unknown emission line in the keV region, which suggests that "cold fusion" is not a nuclear process in this setup, but results from the appearance of new Bohr levels associated with magnetic interactions between nuclei and electrons which appear in certain physical setups.

First suggested long ago by Born and later by Barut [5] and Vigier [6,7], these observations represent the first direct support of a conventional interpretation (within the frame of the present quantum formalism and experimental knowledge of quantum chemistry) of the preceding experiments. This interpretation is based on the forces connecting polarized

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(oriented nuclear and electric) magnetic moments by electric currents in electrolysis or in electric discharges: associated with the electrolytic creation of new Bohr orbits and new quantum states.

One knows indeed that when interacting charged fermions interact in the presence of external magnetic fields, one should add to the Coulomb interactions ($V \sim 1/r$) the action of much stronger electromagnetic forces between their parallel (antiparallel) orientated magnetic moments ($V \sim 1/r^3$). The polarization of nuclear spins by electric currents in the metallic surface of loaded electrodes (capillary currents) or electric discharges in gases theoretically implies (as now confirmed by Szpak et al.) the existence of new "tight" Bohr orbits, i.e. of new "tight" molecules. Corresponding quantum jumps should yield (as now observed) new soft X-rays ($E \sim$ 5–55 keV) associated with exothermic heat energy production. Narrow X-lines are difficult to observe due to the setup's internal dispersion properties.

The existence of corresponding new "tight" forms of H_2 and D_2 molecules is now suggested:

– By preliminary observations on the high loading rate H_2 in Pd, observed by Celani et al. in Frascati [8]. The existence of a new phase of H_2 in Pd is indeed strongly suggested by the level of its concentration (of the order of the magnitude of solid H_2). In our model this should be accompanied by metal cooling and superconductivity associated with the correlated formation of Cooper pairs. This phase is probably concentrated close to the surface of the metallic cathodes since this assumption explains immediately the success of the Patterson device [9], where the use of small Pd balls increases the loading possibility. Clearly the increased efficiency of the Ceti device does not have a nuclear fusion origin since one is working with H_2O only.

– By the significant decrease of usual H_2 molecules in Dufour's glow discharge experiments [3]. This decrease (if one associates $\sim$ 10 keV energy production to each created "tight" molecule) explains the observed energy excess and such new molecular states would leak through the barriers enclosing the setup.

– By the reduction of tritium radioactivity in titanium observed by Reifenschweiler [10], which can be interpreted in terms of nuclear triton pair formation resulting from spin–spin and spin–orbit magnetic interactions which reduce the λ-decay constant.

– By increase of temperatures (excess heat) correlated with the introduction of external magnetic fields (200–800 G) as shown by Bokris et al. [11].

– By new experimental resonances recently deduced and observed by Spence and Vary in proton–electron and electron–positron scattering associated with electromagnetic coupling [12,13]. Moreover the introduction of magnetic fields is correlated with increased excess heat [11].

– By the appearance in plasma discharges of a new "tight" type of H_2O fog possibly associated with the assumed new "tight" Bohr orbits molecules. In Graneau's experiments [14] the expelled water (associated with excess energy by a factor $\sim$ 10) could be directly utilized to create electricity through pression on the piezoelectric setup.

– By the occasional (if one starts with D_2O) observation of strong X-ray and neutron bursts now explained in terms of real "cold" fusion processes resulting from tunnel effects facilitated by the new "tight" Bohr orbits [6,7]. Real cold fusion apparently increases when one increases the energy input.

This suggests that an increase of the energy input will increase the part of the output resulting from real fusion processes: a new path to harness fusion processes completely different from the Tokamak procedure [15].

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