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Do Nuclear Reactions Take Place Under Chemical Stimulation?

J. O'M. BOCKRIS AND G. H. LIN

Department of Chemistry. Texas A&M University, College Station, TX 77843-3255

AND

R. T. BUSH

Physics Department, California State Polytechnic Institute, Pomona, CA 91786

Abstract — Several examples of nuclear reactions occurring under the stimulation of chemical type energies are given. The production of tritium from deuterium in Pd has more than 100 published confirmations. Three models suggest circumstances such that barriers between nucleii may become transparent.

Introduction

In the first years of this century it was thought that atoms were indivisible entities but Rutherford found that a great deal of an atom was free space although it contained at its center a particle, in which was concentrated nearly the entire mass of the atom. He struck N_2 gas with an energetic stream of neutrons and produced O^{17} from N^{14} (Rutherford & Chadwick, 1921).

This seminal achievement founded high energy physics but it also created a mindset which said that breaking into nucleii needed about a million times more energy than is given out in a *chemical* reaction. Large machines (cyclotrons) and nuclear reactors have been thought to be necessary to cause nuclear reactions to occur. However, Borghi (1943) suggested that he had produced neutrons as the result of low energy experiments in a klystron. Keveran (1971) suggested in the 60's that certain facts in biology required the assumption of nuclear reactions and in the 1970's extensive work in U.S. government labs found neutrons produced as the result of sending intense electric currents through wires (Graneau & Graneau, 1994). It was general lack of knowledge of these things which was at the background of the furor which was created when Fleischmann, Pons and Hawkins (Fleischmann ***et al.***, 1989) suggested that palladium heavily loaded with deuterium was the site of a nuclear reaction and Bockris *et al.* (1989) found that deuterium evolved from D_2O-LiOD in aqueous electrolysis contained up to 10^{-9} mole fraction of a tritium-containing species.

It appears that some nucleii split open at the stimulus of only chemical energies.

The Deuterium Palladium System

This system has been examined widely since 1989 and there are more than 1000 reports and papers concerning it already published. However, the system represents a challenge for experimenters since it needs *several weeks* of electrolysis to "turn on" anomalous phenomena (at $D/Pd > 0.9$).

$D/Pd > 0.8$, tritium begins to form at very low yield (Bockris *et al.*, 1989). The tritium formation is 0.1–1% of the amount needed to explain the anomalous heat evolved. Miles and Bush (1991) have found that He^4 is contained in the D_2 gas stream from the electrolysis as well. The *produced amount* of He^4 could explain about half the observed heat if the heat producing reaction is:

$$D + D \rightarrow He^4 + \gamma$$

Correspondingly, Chien Hodko and Bockris found He^4 in their electrodes (1992). Bush and Eagleton (1991) found more than a kilowatt per cc of heat from D-Pd system in a thin Pd film.

Transmutation in Solid Lattices

Bush and Eagleton (1991) have found the formation of Sr from Rb, with the Sr showing an isotopic abundance differing from that of natural Sr, and agreeing with that of a hypothesized Rb parent.

Karabut *et al.* (1992) found (using 3 methods of analysis) that Pd used in gaseous electrolysis in deuterium, contained large numbers of new nucleii. Similar were the findings of K. Wolf (though he used the electrolysis of LiOD in D_2O) (Passal, 1995). Minevski (1995) found that such Pd contained an impurity layer near the surface (~10Å) which mirrored impurities in the electrolyte. Microns deep they found another set of new atoms not present before saturation of Pd with D and Li.

Dash (1993) has reported the formation of silver and gold from palladium electrodes during electrolysis of light water. Ohmori and Enyo (1994) have found that iron is formed in gold electrodes during electrolysis (the isotopic ratio differs greatly from that of normal iron). Stringham and George (1994) found helium and cadmium in a palladium electrode under sono-illumination.

Remarkable recent work by Mizuno *et al.* (1995) has established the creation of the transient isotope Pt^{197} ($T_{1/2}$ = 18.3 hours) by means of passage of content through a ceramic mixture in deuterium gas. He has also found new nucleii (*not* impurities from the solution) on gold electrodes after prolonged electrolysis in D_2O.

Nuclear Changes in Biological Organisms?

Komaki (1967) has worked with microorganisms grown in media which lack one of several nutrients needed. He finds that the needed nutrient atoms arise in the organisms although not present in the nutrient fluid. More recently

Alper (1993) has reported a microorganism called pedomitrobium which appears to produce metallic gold.

Theoretical Comments

Present theoretical rationalization of these reports all relate to nuclear changes *in solid lattices.*

1) Bohm (1951) was the first to point out that, if the internuclear distance between two particles in a lattice attained a critical value related to their de Broglie wave length, the waves would interfere destructively and the energy barrier between the particles would become transparent. The idea has been particularly developed by Bush (1991).
2) Hegelstein (1993) has developed theories in terms of virtual neutrons. If their life time may exceed 10^{-17} sec, they could roam around among atoms in a lattice >10 Å away from the parent, creating new nucleii.
3) Kim and Zubarev (1995) have examined very low energy nuclear fusion using the optical theorem. If the imaginary part of the effective nuclear interactions in the elastic channel has a weak component with a long finite intercation range, the Gamow factor can be modified, and an increase in predicted rate of $>10^{20}$ occurs.
4) A different line of reasoning was published by Greiner and Sandalescu (1990). Traditional concepts of nuclear stability depend on "the strong force" which overcomes proton-proton repulsion but only if the internuclear distance is ~ 1 Fermi. When nucleii are excited they become elliptical and the proton-proton distance may approach 10 Fermis whereupon the vaunted stability should be lost (for H^+-H^+ repulsion will dominate the strong force). The authors mention cold fusion experiments, though independently of those introduced a little earlier by Fleischmann and Pons.

Summary

Several examples of nuclear reactions occurring under the stimulation of chemical type energies are given. The production of tritium from deuterium in Pd has more than 100 published confirmations. Three models suggest circumstances such that barriers between nucleii may become transparent.

There may be keys to Rutherford's fortress.

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