TIP EFFECT AND NUCLEAR-ACTIVE SITES

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Abstract

A high energy concentration in the double layer on the cathode surface is tempospatially observed with the existence of anomalous nuclear transmutation in electrolytic cells. In view of the fact that the energy concentration is associated with protrusions and cracks on the palladium cathode surface, the tip effect model and related nonlinear processes are considered to account for the anomalies of the experimental phenomena. Autoradiography exposure films illustrating the traces of transmutation products of a beta decay type are presented. For the highly oriented traces of charged particles with the energies in the order of keVs, it is allowed to assume the occurrence of micro nuclear reactions(MNR) confined by lattice channeling effect of host metals. The mechanism of such MNR could be explaned by the effects of virtual neutrons and electron capture, or the neutron transfer reactions in a lattice.

Key words: Cold fusion, Electrolysis, Nuclear transmutation

I. INTRODUCTION

Effect of electron environment at nucleus on nuclear reactions has been studied for many years,[1] one of the examples is "Effect of the chemical state on the lifetime of the 24-second isomer of Nb90*" by Cooper et al.[Phys. Rev. Lett. 15, 680(1965)].The weak interaction involved in electron capture(EC), internal conversion and other forms of beta decay is of very short range. Rate of EC is proportional to the density at the nucleus of electrons available for capture. The electron densities at $10^{30}/cm^3$ of spark discharge excist due to micropinch contraction to a degenerate state.[2] Similar conditions may occur on the interface between the electrolyte and the cathode in a electrochemical cell due to tip effect.[3,4]

Highly oriented traces of charged particles observed by the autoradiography of Pd cathodes indicate the occurrence of MNR confined by the focusing and collimation effects of cathode metal lattice channels.[5]

II EXPERIMENTAL DATA

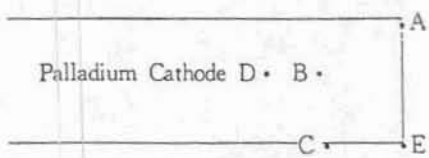
Based on the conception that nuclear transmutations may be focused on the protrusion and crack region, the experimental procedure has been specially decided. The Pd foil cathodes with many edge slits surrounded by anodes of platinum wire were for the purpose of enhancing the inferred tip effect. The electrolytes were light water and heavy water solution of 0.4 mole NaOH. The electrolysis voltage was about 20 V.

After a long electrolytic process(>200 hours), the palladium cathodes were analyzed by

SEM(Scanning Electron Microscope), Synchrotron Radiation Technique, and EDX(Energy Dispersion X-ray Spectrometer) etc. Table 1 shows the anomalous element distribution on the different locations on the cathode surfaces by EDX. Maximal constituent element was Pd, besides, considerable amounts of Mg, Si, Fe, Cu, Zn etc. were contained.

Table 1. Elemental Anomalies at the Surface of Palladium Cathodes after Electrolysis

Location	A	B	C	D	E
Elements Atomic %					
Na	0.2	1.95	1.82	0.28	3.01
Mg	1.79	3.47			
Al	1.33	1.45	16.15		0.33
Si	3.34	1.18			0.49
Fe	11.66	1.68	9.86		0.81
Cu	8.20	2.35	9.91		0.63
Zn	17.50	5.09	19.44		1.03
Pd	52.83	72.84	38.01	97.45	22.12
Pt	3.07	9.99	4.82		0.65



Schematic presentation of observed locations A, B, C, D on the Pd cathode surface. E point presents the result of light water electrolyte. Notice: the elements of C and O are not appeared in the table.

To determine the spatial distribution of radiation active sites(RAS), black white 135 films of 27 Din have been used to image the positions of the RAS. After 1.5 year deposition of finishing electrolysis experiments, the patterns of RAS have been clearly formed on the films after exposure 100 hours. The bright spots corresponding to the slits of cathode edges can be seen (Fig.1)

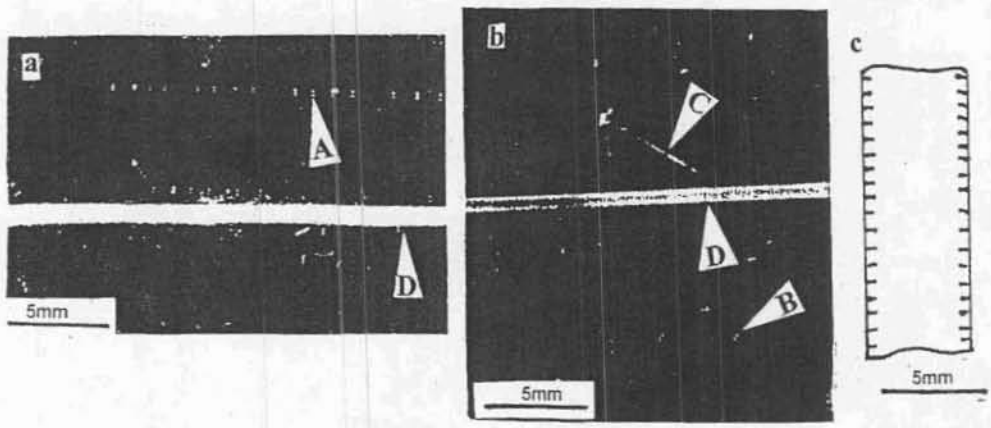


Fig. 1 Autoradiographes of Pd cathodes exposuring 100 hrs with 27 Din. Black white films after 1.5 year deposition of finishing electrolysis, a. Light water NaOH electrolyte, A—Radiated spots, b. Heavy water NaOH electrolyte, B—Radiated spots, C—Trace lines, D—Folding line, c. Schematic presentation of the Pd cathodes with cutting slits.

due to the tip effect. From the configurations of bright spots, one can infer that the most of RASs are located underneath the cathode surface (to see arrows A and B in Fig. 1). Some of bright spots with oriented thin beams (to see the arrows C) show that the RAS were located on the surface of the cathode palladium. It is suggested that the trace beams were formed by beta decay electrons of radiation isotopes with half life time more than one yeas, such as Tritium, Calcium 45, Palladium 107 etc. according to the estimation of stop ranging and spectrum of the electrons radiated from beta decay elements. High concentration of Calcium element has been indeed detected by EDX on the site corresponding to the beam source location (Fig. 2). Further confirmation of the existence of Calcium 45 should be carried out.

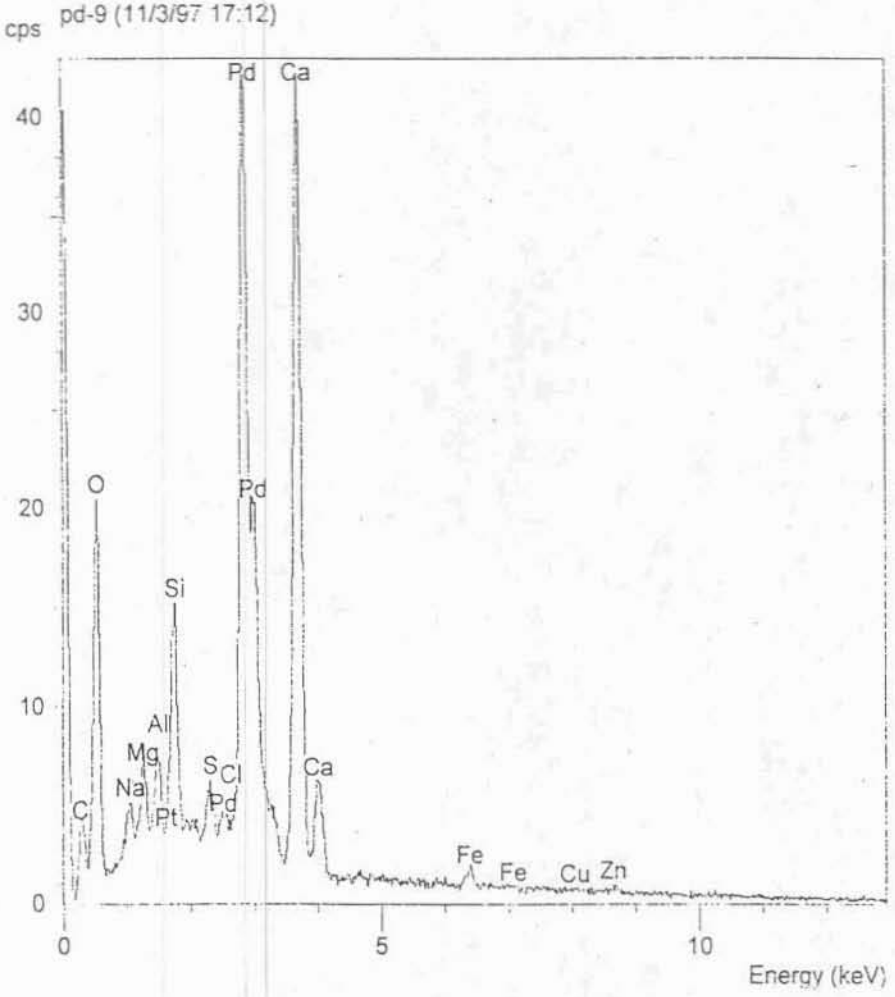


Fig. 2 Spectrum of EDX of the particle indicated by arrow C in Fig.3, b.

The effect of magnetic field on the traces of charged particle has been observed while a magnet was put on the Pd sample exposing to a film (Fig. 3).

No Gamma ray emitted by the samples of Pd cathodes have been detected by a HPGe Gamma spectrometer with low background.

III. DISCUSSION

The electrochemically energy concentration similar to pyrotechnic effect leads to a variety of nonlinear processes.[4]The yields of transmutation products are related to the current distribution

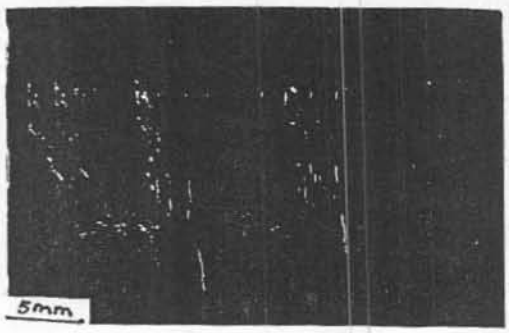


Fig. 3 Autoradiography photo showing the effect of magnetic field on radiation traces. **Sample:** Pd cathode of electrolysis with light water NaOH electrolyte.

on the cathode surface. The contact between beads coated with a thin metallic layer or multilayered film and palladium black particles could be regarded as point contact similar to the tip effect.[6] The processes of nonlinear effects such as quantum tunneling and hopping of hydrogen or deuteron and energy concentration within the contact points, the boundary area and the interface zones would lead to occurrence of the nuclear transmutation for the electrolysis using both heavy water and light water. The enhancement of the ratio of nuclear reactions due to the collimating effect and the focusing effect of the channels of metal crystals should be further studied. If neutron transfer reactions occur,[7] or thermal neutrons and virtual neutrons induced by electron capture processes of deuterons or protons under the conditions of the electron degeneration are produced in the samples, the following reactions will be expected:

$$n+{}^{A}_{Z}M={}^{A+1}_{Z}M \qquad (1)$$

$${}^{A+1}_{Z}M={}^{A+1}_{Z+1}M'+e+\nu_e \qquad (2)$$

Therefore, if elements, such as Na and Al, exist in the electrodes, it is possible to expect the nuclear transmutations generating Mg and Si to occur.[8] The consumption of deuterium or hydrogen has been observed in some experiments. An amount of excess heat about 7 keV per hydrogen atom consumed was found by J. Dufour et al.[9], and the formation of tightly bound state of the hydrogen(deuterium) atom is put forward to explain the results.

The electron capture reactions could be used to explain the production of elements ^{104m}Rh, ^{105}Rh etc. on the surface of palladium electrodes [Karabut et al. Physics Letter A, 170, 265(1992)].

If incident deuterons with energies above 10 keV, many body fusion can be expected due to the channeling effect. The experimental results with the emission of high energy charged particles by A. Takahashi, J. Kasagi et al[10,11] could be explained by the channeling mechanism.

It has been shown that the mechanism of MNR can provide plausible explanation for nonreproducible results of electrolysis fusion experiments and other factors, such as:

* excess heat and nucler transmutation of light water electrolysis;[12]
* excess heat and radiation after switching off electrolysis voltage;
* nuclear transmutation and isotope production only minute area;
* high reaction rates along the lattice channel;
* highly orientated electron traces observed by the autoradiography;
* many body fusion along lattice channels by using deuteron beam implantation;
* time duration dependence of excess heat due to accumulation effect;
* electrolysis current value dependence of excess heat related with electrochemical noise.[13]
* low n/T ratio might be due to the confusion other beta decay elements for tritium[14]。.

An intensive study of anisotropic property of MNRs creating the polarization and excitation

of ellipsoidal nucleus within the crystalline channels should be carried out.

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