

C11.* Analysis of Experimental Data Sets on Critical and Supra-critical Electrolysis by Ohmori et al. [Kozima 2017a]

Nuclear transmutations observed in the surface region of cathodes made of Pd and 5d elements (W, Re and Au) used in normal, critical and supra-critical electrolysis with light water, in addition to some data observed with heavy water, shown in Table C11-1 are analyzed using the trapped neutron catalyzed fusion (TNCF) model [Kozima 2017a]. The occurrence of the cold fusion phenomenon in 5d transition-metal electrodes is consistently explained in accordance with the cold fusion phenomenon (CFP) observed in 3d and 4d transition-metal hydrides and deuterides, such as NiH_x and PdD_x, at the normal electrolysis. The necessary conditions for the realization of the CFP, formation of super-lattice of host nuclei and protons/deuterons in these hydrogen non-occluding materials (at near room temperature), are realized by the higher temperatures of the material induced by a long electrolysis at normal electrolysis (up to three weeks) or by the critical and supra-critical electrolysis with high current densities. Using the data analyzed in this paper in addition to the data obtained in 3d and 4d transition-metals analyzed hitherto, we could contemplate some characteristics of the CF-matter responsible for the nuclear transmutations in the CFP.

Table C11-1 Nuclear transmutations observed in the surface region of cathodes at the critical and supra-critical electrolysis with Graphite, W, Re, Pt and Au cathodes

Cathode/Electrolytic Liquid/Anode	Electrolysis; Normal (N), Critical (C), Supra-critical (SC)	Current density at cathode, (duration of experiment)	Transmuted nuclei (References)
Graphite/H ₂ O/Graphite	SC(Arc discharge in H ₂ O)	100 A/cm ² ,	Fe + Cr, Mn, Co, Ni, Cu and Zn (1)
Pd/D ₂ O +K ₂ CO ₃ /Pt	N C	0.2 – 0.8 A/cm ² , 3.1 – 3.8 A/cm ²	Cr, Fe, Cu, Pb (5) Pd, Au, Hg, Pb(6)
Pd/H ₂ O + Na ₂ SO ₄ /Pt			
W/H ₂ O+Na ₂ SO ₄ + Na ₂ CO ₃ +K ₂ CO ₃ +/Pt	SC	5 A/cm ² ,	Cr, Fe, Ni, Re(2,3)
Re/H ₂ O+Na ₂ SO ₄ + K ₂ SO ₄ +K ₂ CO ₃ +/Pt	SC (glow discharge in H ₂ O)	3 A/cm ² ?	Fe, Cu, Zn (3)

Au/H ₂ O+Na ₂ SO ₄ + K ₂ SO ₄ +K ₂ CO ₃ /Pt	N	0.2 ~ 1.5 A/cm ² , (7 – 30 days)	F, Si, Fe, Pt, Hg (4)
---	---	--	--------------------------

References: (1) [Hanawa 2000], (2) [Ohmori 1999, 2000b], (3) [Ohmori 2000a], (4) [Ohmori 1996a, 1996b, 1996c, 1997a, 1997b, 1998a], (5) [Mizuno 1998, Ohmori 1998b], (6) [Ohmori 1996a, 1998b, 2002, 2004].

Rhenium cathode system; Re/H₂O+Na₂SO₄+K₂SO₄+K₂CO₃/Pt

[Ohmori 2000a]

Leaving other systems than the Re cathode system to the paper [Kozima 2017a], we concentrate our discussion to the Re system in this Appendix.

The rhenium electrode was a square foil (0.8 cm² apparent area, 0.02 cm thick). The counter electrode was a platinum net (1 cm × 10 cm, 80 mesh). The surface of the working electrode was scraped elaborately with a cleaned glass fragment to make a crystal lattice strain. The electrolysis was performed in the light water solutions of K₂CO₃, KNO₃, Na₂CO₃, Na₂SO₄, NaNO₃, NaClO₄, Rb₂CO₃, Ba(ClO₄)₂, and Ba(NO₃)₂.

The condition of the glow discharge can be accomplished as follows; first, pre-electrolysis was conducted galvanostatically at a current density of 2 A/cm² for 1 – 1.5 hours by which hydrogen was loaded in the electrode. Then the current density was increased step-wisely for ca. 30 minutes. When the current density exceeds ca. 3 A/cm², the applied potential turned labile, and, after the passage of several minutes, the electrode incandescenced, and emitted red-violet glow.

When the experimental condition reaches glow discharge, the electric power source operating in the galvanostatic mode switches automatically to the potentiostatic mode owing to the rapid increase in the electric resistance at the electrode/solution interface. As a result, the input potential jumped up to 160 V, and the current density dropped down to 0.8 – 1 A/cm², and thereafter gradually decreased, as a whole, down to ca. 0.5 A/cm².

After the supra-critical electrolysis with a glow discharge, Fe, Cu and trace amount of Zn or only Zn was detected in the Re electrodes at surface layers of widths about 100 Å.

These experimental data obtained by Ohmori et al. [Ohmori 2000a] show that there are detected new elements ^A₂₆Fe and ^A₂₉Cu or ^A₃₀Zn in different electrodes. The A and Z of nuclides relevant to the original system should be noticed at first; ^A₇₅Re (A = 185, 187), ^A₁₉K (A = 39, 40, 41) and ^A₇₈Pt (A = 190 – 198).

The production of Fe is interpreted similarly to the case of graphite and W cathodes. The isotopic ratios of iron generated in the experiments were the same as that of the

natural ones. This correspondence of the products of CF reactions and the primordial production of elements in nature has been interpreted to show an interesting fact of “the stability law” deduced from an overall comparison of CF data with the abundance of elements in universe [Kozima 2011b].

The productions of Cu and Zn also may be explained by the stability law using the data shown in Table C11-2. The elements Fe, Cu and Zn are at peaks of the $\log_{10}H$ vs. Z diagram. The accidental appearance of Fe and Cu or Zn in this experiment may reflect the unknown nature of the CF-matter formed at the surface region of Re cathodes.

Table C11-2 Peaks of $\log_{10}H$ of elements in the universe [Suess 1956].

Z	13	14	20	24	25	26	28	29	30
Element	Al	Si	Ca	Cr	Mn	Fe	Ni	Cu	Zn

The nuclear transmutation observed in CF materials such as palladium-protium and hydrogen non-occlusive metals at room temperature as graphite and 5d elements (W, Re, Au and Pt) with critical and supra-critical electrolysis in electrolytic liquids of light water are explained by the TNCF model [Kozima 2017a] consistently with those observed in 3d and 4d transition-metal hydrides and deuterides with normal electrolysis [Kozima 2006a] and also with those observed in XLPE and in biological microbial cultures [Kozima 2016d].

Necessity of critical and supra-critical electrolysis for the CFP in Pd-H system and hydrogen non-occlusive metals at around room temperature seems to heat the samples (CF materials) to high temperature enough for high proton/deuteron diffusibility and therefore for large extension of wavefunctions of proton/deuteron in the materials [Kozima 2009].

The success in analysis of the experimental data obtained in graphite and 5d-transition metals, containing a lot of hydrogen, given in this Appendix and our paper [Kozima 2007a] has shown the reality of the nuclear transmutations catalyzed by neutrons in CF materials. It is also suggesting the reality of the neutron energy bands in these CF materials realized by the super-nuclear interaction mediated by interstitial protons/deuterons proposed by the present author.