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EXCESS HEAT AND ELECTRICAL CHARACTERISTICS OF TYPE "B" ANODE-PLATE HIGH-IMPEDANCE PHUSOR LANR DEVICES

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Introduction

The binary alloy, PdD_x, has an electrical resistance which is a biphasic function of loading ratio, x. The ratio of metallic electrical resistance of the Pd to its “initial unloaded” value at the same temperature, R/R_0, is used to estimate loading (McKubre). Loading is important to LANR because a loading ratio of ~0.85 D/Pd, is required to generate excess heat from an active LANR material, although issues of confinement time (weeks), adequate deuteron flux, requisite activation energy, maintaining structural lattice integrity, phonon support, and maintaining optimal operating point operation are also critical are ignored for the moment. H- and D-drift experiments indicate a fractional electronic charge dressing of the protons so that there is a fractional charge in the range of +0.42 to +0.7. Luo and Miley have considered that the fractional positive charge is a dynamic property, associated with the hopping process within the lattice. The implication is that deuterium ions are at least partially screened by the conduction electrons from the palladium, even for loading ratios less than x=~0.55. For pure palladium, reciprocal space analysis shows six bands near the Fermi surface. Three bands cross through it, and another three are nearby, one of which becomes decisive at higher loading. Electron-phonon scattering is usually considered, while electron-electron scattering is not. Also, usually ignored is the role of Pd vacancies, which have similar incremental resistivity effects (Xu). The electrical resistivity of palladium is described by the Bloch-Gruneisen formula, except for electron-electron scattering.

As hydrogen is added to palladium, while loading continues up to x=~0.5, the hydrogen donates its electron to fill up the unfilled palladium d-shell (0.36 holes in its d-band revealed by deHaas-vanAlphen experiments), its electron enters a hole thereby increasing resistance. This is heralded by the decreasing Debye temperature indicating a reduction in the total number of available electronic carriers. There is an initial linear rise in the resistivity ratio. Loading above x=0.5 takes energy. By x=0.6, the electron donation from deuterium to the lower lying bands end, as the bands become full. Gap energy is now required, as the filling shifts to the "sixth band" (Luo). With that, there is an increase in charge carriers, and the observable decrease in the electrical resistivity ratio making the resistivity ratio-loading curve biphasic. Loading has been examined several ways. For example, Otterson and Smith have done meticulous work using a graphite anode using retention studies and resistivity ratio measurements carefully done at high loading, and have noted that the palladium is two inter-penetrating face-centered cubic lattices. They have proposed H/D movement from the interstitial octahedral sites of the palladium lattice to the tetrahedral sites. Other possibilities include double octahedral site occupancy and new phases. Asami has examined the lattice constants during the phase change from alpha to beta phase (and did not find any other higher-loading putative phase up to loading ratios of x=0.9). Important, but less often considered, are the inhomogeneities in the D distribution, polycrystalline Pd (loads poorly), and roles of dislocations, fractions, grain boundaries, and competing hydrogen (H vs. D) which impact D loading- and loss-rates, flow, and distributions.

Results and Discussion

This paper reports on the LANR behavior and metallurgical electrical behavior of Type "B" (anode plate) Pd/D_2O/Pt Phusor® type LANR devices driven at their optimal operating point (OOP), using 4-terminal Pd conductivity, near-IR, calorimetric and heat flow measurements. Two current sources are used to drive and interrogate the device. Figure 1 shows the excess heat generated by the Type "B" Pd/D_2O/Pt Phusor® LANR device, based on the input power normalized delta-T data of ~175%, compared to the output heat created by dissipation from an ohmic control in the same electrical circuit. At initiation, the wet electrical resistance of the heavy waterr electrolytic cell was 253.6 kilohms. This experiment consisted of increasing input electrical currents, in pulses, such as seven pulses to the ohmic control of differing input electrical power, and then fourteen different power levels applied to the cathode. The latter received from 1 microampere up to 20 milliamperes, which produced a peak potential of 99.7 volts between the cathode and anode. The peak power dissipated was 1.99 watts.

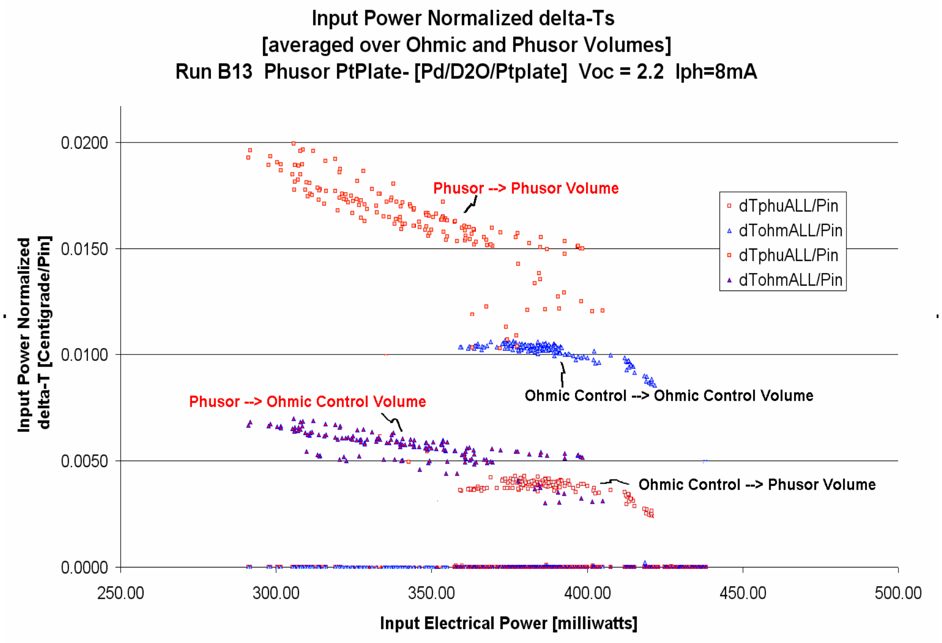

Figure 1 – Input Power Normalized delta-T of a Type "B" LANR device and Control

The excess energy is greater than that available by energy storage, and it is not energy storage based on time integration. The excess energy can only have a nuclear origin because its magnitude is beyond the chemical energies available even including all reactants and their containers. There are negligible changes in electrodes, no substantive change in reactants (except loss of water), and no significant products (corrosion products, flocculation, chemical deposition).

Applying an electric field intensity to the solution and cathode resulted in a near-linear rise in 4-terminal electrode resistance. This was not seen when the ohmic control was driven. At the higher levels of loading, excess heat was observed. Importantly, as Figure 2 shows, during synchronous 4-terminal measurements of palladium transconduction, while driving the 6-terminal Type "B" LANR devices, there are two temporal components to intrapalladial conductance decreases to loading for these 6-terminal Type "B" Phusor^{TM} LANR devices. The shorter time constant (<5 seconds) cannot be due to deuteron loading.

There are several possibilities, including possible electrodynamic ordering of the intrapalladial deuteron lattice, or another electrodynamic effect which controls palladium electric conductivity. It might have a possible component of cross talk through the palladium, and efforts are underway to semiquantitatively address and remove this is as an issue. It may also result from a momentum change from the applied electric field intensity upon one, or both, of the charge carriers, or their scattering. If, when improved geometry is available, with both metachronous and synchronous extensive testing, this persists, then there are two possibilities. To the degree that axial electronic or deuteron electrical conduction in the cathode goes through the surface of the electrode, the application of the power source driving the LANR may cause incremental loading, polarization, and structural (including through plasmons, polarons) changes that interfere with the surface conduction. On the other hand, to the degree that axial electrical or deuteron conduction in the Pd LANR cathode goes through the bulk of the 1mm diameter wire (more likely based upon the actual magnitude observed of the devices which is in the range of ~50 milliohms), the application of the power source driving the LANR may cause a field- or polarization-induced coherence change in the organization of the deuteron lattice, thereby, interfering with the volume conduction. Our initial calculation based on the values of the resistivity support the latter.

Using synchronous 4-terminal measurements, prior to this excess heat, there is a supralinear rise of intrapalladial electrical resistance for applied voltages (to the solution) >78 volts. This, and the electrodynamic initial changes, may have a triggering role in LANR. Finally, at high loading, previously an instability oscillation has been noted in the resistivity ratio (Luo), which we have confirmed. We propose that this oscillation may be an observed electrodynamic component.

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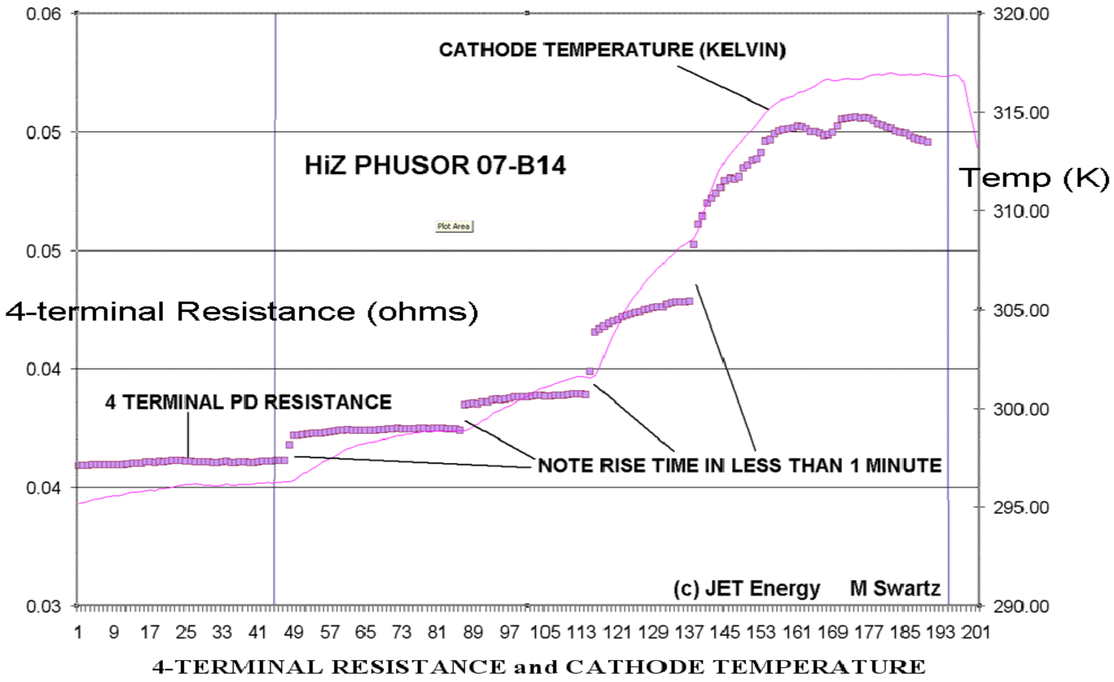

Figure 2 – Pd Resistance and Temperature of a Type “B” Phusor LANR Device

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