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**Trip Report from Bor Yann Liaw**
**3rd International Conference on Cold Fusion**
**October 21-25, 1992, Nagoya, Japan**

I attended the 3rd International Conference on Cold Fusion (ICCF) at the Nagoya Congress Center in Japan on October 21-25, 1992. This conference was part of a series following the Salt Lake City (1990), Provo (1990), and Como (1991) meetings on cold fusion. ICCF was chaired by Professor Hideo Ikegami of the National Institute of Fusion Research in Nagoya. The Wall Street Journal, Business Week, and several US and Japanese newspapers reported on ICCF describing the recent cold fusion field development.

The meeting was highlighted by several interesting results. The Takahashi experiment caught much attention among his peers. He reported high level excess heat results and the correlation with neutrons. The excess heat experiment was recently repeated by Edmund Storms in the Los Alamos National Laboratory. Similar neutron spectra were also reported by an Italian group (Bressani, et al.) and a Russian group (Guteroff). The neutron spectrum showed a high energy tail between 3-8 MeV besides the 2.5 MeV peak, indicating an anomalous possibility of d+d+d type multibody nuclear interaction in solids.

Another highlight of the conference was the charged particle results from Yamaguchi's group in NTT. This result clearly demonstrated an on-line time-dependent $^4He$ formation in a deuterium loaded palladium system. This work used an in-situ reactive system for detection of $^4He$, $^3He$ and tritium. They used an on-line Si solid-state detector (Si-SSD) to monitor charged particles. The system was also equipped with neutron detectors and a high-resolution mass spectroscope to differentiate light elements. Yamaguchi considered a high loading and strong far-away-equilibrium state (at surface or in vacuum) are essential to induce the anomaly effect reported by Pons and Fleischmann. He has published papers on his earlier results in neutron detection, in which a burst of neutrons in the order of $10^6$ n/sec was measured during the burst of explosive deuterium gas evolution accompanying a uniform biaxial plastic deformation of the Pd plate.

In a typical setup of his experiments, two Pd plates of 3 x 3 x 0.1 $cm^3$ were vacuum annealed at 400°C for more than 12 hours, then coated with a Mn-oxide film (200A) on one side and loaded with 02 gas at 330°C. After sufficient loading was achieved during a 60-hour cooling, the Pd plates were coated with an Au layer (2000A) to prevent outgassing. After a Si-SSO was mounted and the system was evacuated, the Pd samples were exposed to an electric field, and the charged particles emitted were detected. He found sample temperature rose in the beginning of evacuation accompanied with 02 evolution on the mass spectrum. After two hours of operation, another temperature rise was observed and the presence of a $^4He$ peak was shown on the spectrum as well as a HT peak. This observation repeated in other runs when mixtures of O2/H2 in different proportions were used. However if only $H_2$ was used, no $^4He$ nor HT peaks were detected. They used different energy barriers to distinguish the a-particles and confirmed their existence. This is the first clear evidence of simultaneously detecting excess heat (as the second temperature rise in the sample), $^4He$, T, 3 MeV p and 4.2 MeV a in a single experiment. They will analyze 3He in their future experiments.

Dr. Michael McKubre reported SRI's recent results. He emphasized the importance of the pretreatment of electrodes and an in-situ formation of ionic-conducting Si,Al-oxide films in assisting attaining the loading. Their electrodes can be loaded in excess of D/Pd = 1. The excess heat has been shown to have both baseline (30-50%) and burst-like (200-500%) characteristics, which are reproducible when the loading is monitored and controlled. He reported the criteria for excess heat production to be: 1) loading exceeds the ratio D/Pd 2: 0.85; 2) loading should be "matured" after 2:300 hours of conti.,uous charging; 3) current density 2: 200 $mA/cm^2$ is required. The excess power has an exponential dependence on loading when D/Pd 2: 0.85.

Dr. Kunimatsu from IMRA, Sapporo, Japan, further reported the use of a fuel cell anode for heavy water electrolysis and the importance of minimizing overpotential to enhance loading. He obtained excess heat when D/Pd 2: 0.83 and i 2: 100 $mA/cm^2$. He also demonstrated that the use of Pd and Ni resulted in a different thermal response. Pd, which absorbs a large quantity of deuterium, produced excess heat; while Ni, which does not take much deuterium, yielded none. He further quantified the relationship between loading and current density and found the critical current density of 100 $mA/cm^2$ was the minimum to achieve D/Pd 2: 0.83, but often depends on surface impurities. He can correlate the current density to excess power as a power law. However, McKubre cautioned the importance of an isothermal condition, and Fleischmann commented on the dependence of temperature on excess power, which favors our molten salt approach.

Dr. Thompson, who was associated with Johnson-Matthey and is now an independent consultant, reported an analysis of Pons-Fleischmann electrodes used in their original paper. Microstructural analysis using SEM showed the electrodes have cracks and scratches that increased with current densities. He also reported the impurities found on the electrodes to be mostly Cu, Zn, Fe, and Pt, which were similar to our molten salt electrodes - it is quite an interesting coincidence.

Professor T-P. Perng from Tsing-Hua University in Taiwan reported their recent progress in excess heat and neutron measurements. The group found that neutron emission depended on the dimension of the Pd electrodes used in the heavy-water electrolysis. When the Pd diameter was less than 2 mm, the signal of neutron emission became undetectable. They ran the electrolysis cell at about 85°C and, in some cases, they observed boiling off of the electrolyte and the cooling water outside the cell. They also reported replication of the molten salt experiments, in which large amount of excess power was measured. This is the first confirmation of our molten salt results by an independent group. They also detected neutrons in the molten salt experiments, which is unique. Another interesting finding from this group is the TEM study of the annealed Pd samples, which displayed a superlattice -phase structure. This was unexpected because of the low concentration of the hydrogen in the annealed sample. They are looking into this result more carefully.

De Ninno, from Scaramuzzi's group, reported the detection of excess heat and $^4He$ in their experiments. She monitored the hydrogen pressure variation in the backside of the electrode. In a 200 hour run, the pressure dropped continuously indicating the loss of loading in a long term charging. She warrants the importance of the cell geometry, thus the uniformity of the field imposing on the electrode.

Pons reported their electrolysis experiments that were close to the boiling off events. He showed the audience a video tape of the actual boiling off phenomenon of four separate cells that, in their estimation, were giving off 140 W of excess power over a 37.5 W input. He also claimed the excess power level at 1.8 $kW/cm^3$ which is about two times more than what we measured in the molten salt experiment. He also showed a video of their laboratory in southern France, which is under the support of IMRA Europe, part of the Technova consortium in Japan.

Professor Peter Hagelstein in MIT reported his recent theoretical work in which neutron transfer reactions were proposed to explain most of the phenomena reported. A resonance scattering model similar to the Bragg scattering was used to explain the excess heat. He proposed an interesting mechanism in which resonance domains of several microns in dimension and the phonon coupling are incorporated to help release the energy from the nuclear reaction to lattice as heat. He has a vigorous mathematical formulation to backup his hypothesis and is waiting more isotope shift evidence to support his theory.

Professor Praparata from University of Milan described his quantum electrodynamics (QED) theory to explain cold fusion. He proposed a coherent quantum plasma model to formulate the nuclear particles as coherent waves, of which the coherent state is the true ground state. The occupation of hydrogen in different sites in the Pd lattice can represent different plasma density which could lead to the coupling of nucleus in an coherent domain of several microns in dimension. The occupation of the tetragonal-site seems important in enhance the coupling. This can only happen when loading is over a critical value, namely D/Pd 0.83, from his calculation, which is quite consistent with the results of McKubre and others.

Tom Claytor from Los Alamos National Laboratory reported tritium evolution from the Pd-D-Si cells. He used a Pd,Si-multilayer structure in gas loading. Under a 100 psi pressure and a high voltage about 1-2 kV, the cell can carry a current of about 5 mA. He carried out an on-line monitoring of proton and tritium variation over 600 hours of operation. Significant tritium production was measured in the Pd-D system in contrast to a low-level enrichment in the controlled Pd-Hand $D_2$ gas systems. Using an arcing process showed no enhancement of the tritium concentration.

Professor John Bockris from Texas A&M reported tritium production from electrolysis cells and found $^{4}He$ in the electrodes which is similar to what we have reported previously in our molten salt experiments. Nine out of ten electrodes used in his laboratory showed at least 5-6 times off-background $^{4}He$ signals when the samples were analyzed by ETEC. In one case the signal was 300 times higher than the background. They also found Cu deposited on the Pd electrode can assist the tritium production. They are trying to use X-ray fluorescence by laser excitation to detect $^{4}He$ during electrolysis as an on-line analysis tool.

In summary this meeting corroborated the evidence of several important aspects of the anomalous effect which have been discussed already in the previous Como meeting:

- the need of a high loading over the critical threshold, D/Pd 0.83
- the evidence of excess heat and $^{4}He$,
- a collective phenomenon of high concentration of deuterium in metals which may result in a "new solid state nuclear science" - a surprise from a conventional point of view and understanding.

It should be noted that the Ministry of International Trade and Industry (MITI) of Japan will provide 200 million yen to support cold fusion research next year. The program is called "New Hydrogen Energy." On October 26, MITI organized a meeting to invite participants in the conference to report the most recent progress made in this field. Although the issues still remain controversial, the outcome seems to corroborate MITI's decision.

After visiting several laboratories in the following few days, on October 29 I returned to Tokyo to take the flight back to Honolulu and adjourned this interesting journey.