ABSTRACT

An abstract of the thesis of Conrado Salas Cano for the Master of Science in Physics presented July 8, 2002.

Title: Comparison of Heat Output and Microchemical Changes of Palladium Cathodes under Electrolysis in Acidified Light and Heavy Water.

Two experiments have been conducted to ascertain if a cell with a palladium cathode, a platinum anode, and a solution of H_2SO_4 in D_2O can produce excess heat under electrolysis compared to a similar cell with H_2O. In each experiment, two cells were connected in series with constant current. The two cells were identical except for the fact that the heavy water cell used D_2O instead of H_2O in the electrolyte. Both cells in each experiment employed Pd cathodes, Pt anodes, and H_2SO_4 in the solution.

On a piece of Pd foil that had been cold-rolled and cleaned like the cathodes but had not been electrolyzed, scanning electron microscopy (SEM) and energy dispersive spectrometry (EDS) failed to find any traces of unexpected elements.

In the first experiment the indication was that the light water cell was slightly warmer despite receiving slightly less power. Small amounts of silver were found on both cathodes after electrolysis.

In the second experiment, the D_2O cell produced an excess heat relative to the H_2O cell that was too large by at least an order of magnitude to be explainable by chemical reactions or mechanical artifacts.

After electrolysis, it was found that Cd was present on the surface of the H_2O cathode at levels of concentration that were variable but generally no less than 4% relative to Pd (above 3σ). The H_2O cathode of this second experiment finished electrolysis very straight.

The D_2O cell cathode finished severely arched ($\sim 30^{o}$), with its convex side facing the anode, and covered in a deposit of powdery black substance which was most likely PdS formed accidentally on the first day of this experiment when the D_2O cell had been run with the wrong polarity. On this D_2O cell cathode, no statistically significant traces of Cd were detected but Ag was present in 2-5% concentration relative to Pd. In some spots, the Ag abundance surpassed 20% that of Pd. The most likely explanation is neutron-induced nuclear transmutation of some of the Pd nuclides with direct release of heat into the solid-state lattice.

COMPARISON OF HEAT OUTPUT AND MICROCHEMICAL CHANGES OF PALLADIUM CATHODES UNDER ELECTROLYSIS IN ACIDIFIED LIGHT AND HEAVY WATER

by

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