Anomalous Exothermic and Endothermic Data Observed by Nano-Ni-Composite Samples

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This is an experimental paper summarizing the observations of anomalous data on excess heat, D(H)-loading and abrupt desorption with endothermic heat sink in Ni-nano-composite samples under D(H)-gas charging at both room and elevated temperatures, done by Kobe-Technova group in 2012-2013.

Referring to our JCF12 paper (Y. Miyoshi et al., JCF-12-1) on Pd_1Ni_7/ZrO_2 samples, experimental procedure and results reported for Ni/ZrO_2, $Cu_{0.21}Ni_{0.21}/ZrO_2$ and $Cu_{0.08}Ni_{0.36}/ZrO_2$ samples (partially reported in our JCF13-15 paper by Sakoh et al.) will be summarized. We have reanalyzed time-dependent data for speculating heat releasing mechanisms during the long (several weeks) lasted phase of D(H)-loading-into-nano-metal. It seems that competing process of D(H)-gas sorption and desorption at the surface of nano-powders would be attributed to the mechanism.

Burst-like heat peaks of η-values (in unit of eV per D(H)-take-in/out) were observed with anomalously high values reaching 600 eV/H-sorption, and with smaller η-values for isotopic D-sorption than H-sorption, at 573K. Integrated heat values for several-week runs were reached at the levels of ca. 800eV/atom-Ni for $Cu_{0.08}Ni_{0.36}/ZrO_2$ samples, which were about 10 times larger than those of Ni/ZrO_2 samples and about 4 times larger than those of $Cu_{0.21}Ni_{0.21}/ZrO_2$ samples, at temperatures of 523 to 573K.

In the pre-treatment runs at 573K, very anomalous abrupt desorption phenomenon with rapid decrease of loading ratio and heat-level (heat-sink phenomenon) were repeatedly observed for all Nano-Ni composite samples. Observed heat-sink energy per D(H)-desorption was around 50-80 eV, which is too large to be explained by H(D)-bonding energy to any metal. Displacement/knock-on of plural Ni-atoms by a proton/deuteron desorption might cause ca. 40 eV per Ni-displacement for energy absorption. If so, we may speculate that vacancies/defects would be formed in Ni-core-lattice and multi-atomic H(D)-clusters would be trapped there in the post-pre-treatment D(H)-charging runs. (These clusters might be seeds to induce anomalous heat effect, which might be some nuclear origin, for further main runs of D(H) charging by elevating temperature above room temperature.)

After the pre-treatment, we took data by elevating temperature from 373K up to 573K. We did not observe the anomalous 'abrupt' heat sink events by desorption and did observe excess power showing rather monotonous evolution. We need repeated experiments to conform the phenomenon.

No visible increase of neutron counts (by ^3He counter) over natural background has been observed until now. Very slight increase of gamma-ray counts (by NaI counter) was sometimes recorded, but we need spectral and heat-cross-correlation-based confirmation in further scaled-up experiments (See our report from A. Kitamura et al in this Conference).