A Mass-Flow-Calorimetry System for Scaled-up Experiments on Anomalous Heat Evolution at Elevated Temperatures

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We have been studying phenomena of anomalous heat evolution from hydrogen-isotope-loaded nano-composite samples at elevated temperatures as well as at room temperature using a twin absorption system [1, 2]. Recent experiments have used Ni-based nano-composite samples; Pd_1Ni_7/ZrO_2 ("PNZ"), Ni/ZrO_2 ("NZ"), $Cu_{0.081}Ni_{0.36}/ZrO_2$ ("CNZ") and $Cu_{0.21}Ni_{0.21}/ZrO_2$ ("CNZII"). The results of measurements have been presented in the meetings of the 12th Japan CF-Research Society (JCF12), the 17th International Conference on Condensed Matter Nuclear Science (ICCF17) and the 13th Japan CF-Research Society (JCF13), and have been/will be published in [3], [4] and [5], respectively.

These will be summarized, and the time-dependent data will be re-analyzed in another paper by A. Takahashi in this Conference for speculating heat releasing mechanisms during the several-week-lasted phase of D(H)-loading into the nano-composite samples. As will be shown there, a lot of interesting, even astonishing, features are involved; burst-like heat release with anomalously high values of differential heat of sorption (η) reaching ca. 600 eV/atom-H, large values of integrated heat reaching ca. 800 eV/atom-Ni from the CNZ sample absorbing H, and abrupt desorption with absorbed energy of 50 - 80 eV/atom-Ni observed almost exclusively in the first 573-K run for each sample.

To confirm the interesting phenomena, repeated measurements with improved signal-to-noise ratio are required. Since the easiest way for this is to increase the sample amount, we have fabricated a reaction chamber with a ten-times-larger volume than in-being one. Another important improvement is a mass flow calorimetry applied to the system using an oil coolant with a boiling point of 390 deg-C. Moreover, to make residual gas mass spectral analysis in A = 1 - 6 amu range, a QMA system is going to be installed in the line of the apparatus.

In the presentation we will show the schematics of this new oil-cooling mass-flow calorimetry system for observing anomalous heat evolution in H(D)-gas charging to Ni-based nano-composite samples and for calibration runs using blank alumina sample.

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