

## Research Status of Nano-Metal Hydrogen Energy

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Two MHE facilities at Kobe University and Tohoku University and a DSC (differential scanning calorimetry) apparatus at Kyushu University have been used for excess-heat generation tests with various multi-metal nano-composite samples under H(or D)-gas charging. Members from 6 participating institutions have joined in planned 16 times test experiments in two years (2016-2017). We have accumulated data for heat generation and related physical quantities at room-temperature and elevated- temperature conditions, in collaboration. Cross-checking-style data analyses were made in each party and compared results for consistency. Used nano-metal composite samples were PS (Pd-SiO<sub>2</sub>) -type ones and CNS(Cu-Ni-SiO<sub>2</sub>)-type ones, fabricated by wet-methods, as well as PNZ (Pd-Ni-Zr) -type ones and CNZ (Cu-Ni-Zr) -type ones, fabricated by melt-spinning and oxidation method. Observed heat data for room temperature were of chemical level.

Results for elevated-temperature condition: Significant level excess-heat evolution data were obtained for PNZ-type, CNZ-type CNS-type samples at 200-400°C of RC (reaction chamber) temperature, while no excess heat power data were obtained for single nano-metal samples as PS-type and NZ-type. By using binary-nano-metal/ceramics-supported samples as melt-span PNZ-type and CNZ-type and wet-fabricated CNS-type, we observed excess heat data of maximum 26,000MJ per mol-H(D)-transferred or 85 MJ per mol-D of total absorption in sample, which cleared much over the aimed target value of 2MJ per mol-H(D) required by NEDO. Excess heat generation with various Pd/Ni ratio PNZ-type samples has been also confirmed by DSC (differential scanning calorimetry) experiments, at Kyushu University, using very small 0.04-0.1g samples at 200 to 500°C condition to find optimum conditions for Pd/Ni ratio and temperature. We also observed that the excess power generation was sustainable with power level of 10-24 W for more than one month period, using PNZ6 (Pd<sub>1</sub>Ni<sub>10</sub>/ZrO<sub>2</sub>) sample of 120g at around 300°C. Detail of DSC results will be reported separately. Summary results of material analyses by XRD, TEM, STEM/EDS, ERDA, etc. are to be reported elsewhere.