Nanosecond Pulse Stimulation in the Ni-H_2 System

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Brillouin Energy and SRI International (SRI) have been performing calorimetry measurements on the Ni/ceramic/Cu coatings in a H_2 atmosphere with nanosecond pulses applied between the Ni and Cu. The reactive cores have been described earlier [1]. We have been testing new materials, material fabrication techniques, and electrical stimulation methods to produce power and energy output in excess of that reported earlier. In addition to the pure metals, we have investigated systems using Ni-Pd coatings.

By applying fast pulses [2] of several hundred volts and tens of nanoseconds long, the current follows the "skin-effect" principle and is concentrated at the Ni-ceramic interface but returns through the bulk of the Cu. Two stimulation methods were used – steady-state and dynamic. In the steady-state method, the pulse power is measured directly using fast oscilloscopes that record the voltage across the core and a shunt resistor in series with the core. The input pulse power is determined by multiplying the calculated root-mean-square voltage and current and recorded every 10 seconds. Figure 1 shows typical waveforms collected from the oscilloscope and the calculated pulse power.

Using a sophisticated model of the calorimeter with up to 15 coefficients, the power reaching the five temperature sensors is determined during simultaneous continuous ramps of both heater and pulse powers. The power emanating from the core is determined during sequences of more frequent low voltage pulses (LVP) and compared to that found using less frequent high voltage pulses (HVP). The power determined during the more frequent LVP is set as the input power during that sequence. The power of the stimulation pulses during the less frequent HVP sequences is maintained equal to that during the more frequent LVP. Then the power calculated from the core is divided by that calculated during the reference sequences, giving a so-called coefficient of performance (COP). Table 1 below presents some of the recent results obtained using this dynamic stimulation method. Because the analytical method used for the dynamic stimulation is different from that used earlier with steady-state stimulation, a correction was applied for better comparison. The corrected results are presented in the last column in the table. The actual excess powers in the first column are up to three times greater than those measured earlier.

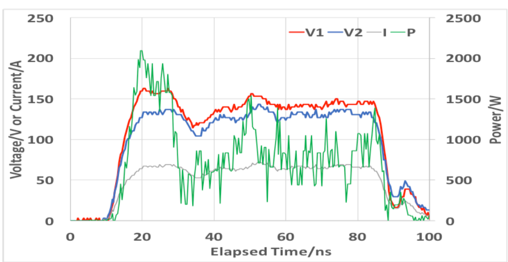

Figure 1. Stimulation pulse power analysis

QREACTION /Watts	COP using DS method	COP using legacy method
3.62	1.25	1.56
3.59	1.26	1.55
3.90	1.27	1.62
4.91	1.31	1.56
4.99	1.31	1.58
4.85	1.31	1.58

[1] F. Tanzella, R. Godes R., et al. "Controlled electron capture: enhanced stimulation and calorimetry methods", J. Condensed Matter Nucl. Sci., vol. 24, pp. 301-311, 2017.
[2] R. Godes, "Drive circuit and method for semiconductor devices", US Patent 8,624,636, 2014.