Radiant calorimetry of excess heat production in NiCu multilayer foil with hydrogen gas

[#]J. Kasagi[1], T. Itoh[1,2], Y. Shibasaki[2], T. Takahashi[2], M. Saito[2] and Y. Iwamura[1]

[1] Research Center for Electron Photon Science, Tohoku University, Japan

[2] Clean Planet Inc., Japan

E-mail: kasagi@lns.tohoku.ac.jp

It is shown in the NEDO project [1,2] that a nano-structured composite metal with hydrogen gas produces anomalous excess heat (AEH) when samples are heated to several hundred degrees. We have developed more convenient heat-generating method [3], using a multilayer composite metal thin film instead of the amorphous metal powder. The method is superior as follows; easy to make samples, good reproducibility of AEH, easy to observe low-energy radiations. However, the values of the excess heat deduced so far include non-negligible reducible uncertainty, because the evaluation is based only on thermometry, the temperature of the sample core.

In order to reduce the uncertainty as well as to obtain much information on light emission, we are developing radiant calorimetry in which light radiation emitted from the sample is detected over a wide range in wavelength. Employed are a thermometer TMHK-CLE1350 (wavelength 3-5.5 μm) for mid-IR, an FTIR spectrometer Hamamatsu C15511 (1.5-2.5 μm) for near-IR, and a spectroscope Hamamatsu C10027 (0.3-0.9 μm) for visible light.

Extensive spectral measurements of light radiation provide visual evidence of excess heat power. One can see such an example in Fig. 1, which compares the two spectra measured with (red dots) and without (blue dots) H_2 in the NiCu thin film sample heated by the input power of 34.5 W: the red dots exceed the blue dots over the entire region. This difference of radiant intensity is clearly the excess power due to the reaction involving H_2.

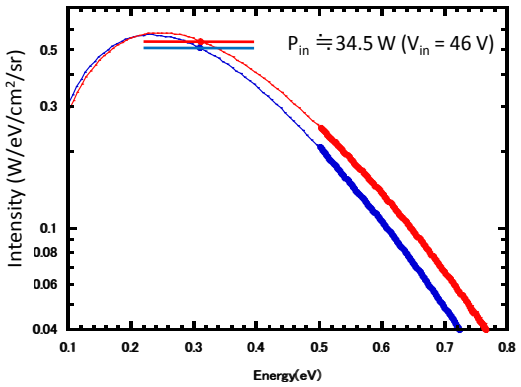

Fig. 1 Light spectra emitted from NiCu multi-layer thin foil; measured without H_2 (blue) and with H_2 (red).

Detailed analysis reveals the difference of the foil without and with H_2 in other physical quantities more specifically: the temperature rises from 942K to 992K, the amount of radiation increases by 6.2%, the emissivity reduces from 0.144 to 0.124. The total excess power is evaluated to be 6.0 W, in this case.

In the present work, we show the result on two types of samples: (1) nanostructured Ni-Cu multilayer film deposited on a Ni plate and (2) pure Ni plate which is used as a substrate of (1). The heat flow analysis was performed based on the temperature measured at three points of the sample holder, the sample surface temperature, and the total radiant heat flow from the sample surface. It was found that the excess power of 2 – 6 W was observed for the sample (1) and the total energy produced in 120 hours was 0.72 MJ that corresponds to 3.8 keV/H atom. Experimental details and results of measurements will be discussed in detail.

References

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