

§17. Improvement Devices to Measure the Partial Pressure of Out-gases during Microwave or Conventional Heating

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Many characteristic phenomena of microwave heating are reported recently¹⁾. One of the microwave effects, it is reported that chemical reaction accelerated by microwave heating.

Authors paid attention to the reduction reaction. We develop the device to measure the partial pressure of oxygen last year²⁾. This year, we improve of that to be able to experiment not using hear insulator, and use the electric furnace which can heat up to 1600°C.

i). High vacuum device to measure partial pressure of oxygen

Fig. 1(a) shows schematic view of the high vacuum device to measure partial pressure of oxygen. This device was made from the stainless steel. Before experiment of partial pressure of oxygen, we heated device above 200 °C in order to take away the absorption water and gas. The turbo molecular pump (TG50F, OSAKA VACUUM Ltd., Osaka, Japan) is able to vacuum up to ultra-high vacuum levels ($\sim 10^{-6}$ Pa). Because this vacuum levels is molecular flow region, we are able to do the In-situ measurement of the outgas analysis. Sample temperature was measured by infrared radiation thermometer (FTZ6-R220, Japansensor, Tokyo, Japan) and two color thermometer (IGAR12-LO/MB13, IMPAC, Germany). Total pressure of this system was measured by full range vacuum gage (PKR251, HAKUTO Co., Ltd., Tokyo, Japan). And we can analyze the partial pressure of outgas by the quadruple mass spectrometer (QMG220, Pfeiffer Vacuum Inc.). We are able to calculate the partial pressure of oxygen of outgas with data of quadruple mass spectrometer and exhaust velocity of turbo molecular pump.

A sample is in the double tube. For double tube, a sample is to be vacuum insulation.

The double tube which made from quartz glass set in the electric furnace or microwave cavity (Fig 1. (b)). Using this system, we can heat the sample by electric furnace/microwave cavity in the same measurement systems.

When we use the electric furnace which can heat up to 1600°C, we replace the double tube to the alumina tube which can resist up to < 1600°C.

ii). Microwave heating system

Fig. 1(c) shows the schematic view of the microwave heating apparatus. In this applicator, magnetron which can outputs 1.5kW within the range of the frequency of 2.455 GHz \pm 10 MHz (PMJ-1000-L, EWIG Co. Ltd., Tokyo) was used. And a single-mode cavity was utilized, which have a waveguide of TE₁₀₃ mode. A plunger is set at the end of the waveguide. This plunger was made up of a metal wall and

acts as reflects electromagnetic waves. This metal wall slides back and forth by linear motor (CPL28T08B-06, Orientalmotor Co., Ltd., Tokyo, Japan). This plunger is high precision, thus we are able to control temperature of the sample more easily than previous microwave system.

A test tube was placed in the waveguide at the maximum point of electric or magnetic field. Heating was performed with tuning the power of the reverse wave to be minimized by manipulating the three stub tuners and the plunger. Input power and reverse power are monitored by a power monitor. This data was sent to the data logger. Isolator which assembled next to a magnetron is used to prevent reflected waves from waveguide.

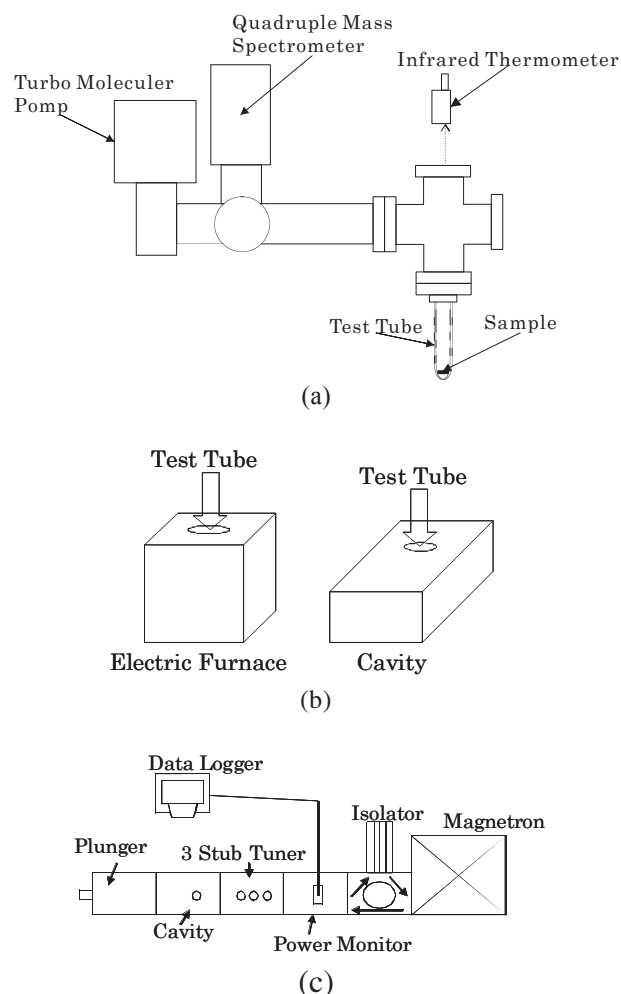


Fig. 1. (a) Schematic diagram of Microwave heating apparatus. (b) Schematic view of that the test tube set in the electric furnace or microwave cavity. (c) Microwave heating system. Using this system, we can divide into microwave electric and magnetic fields spatially.

- 1) Sato, M. et al: Proc. MAJIC 1st, Otsu, Japan (2008) 5
- 2) Fukushima J. et al. Annual report of national institute for fusion science (2009), 420, ISSN 0917-1185