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This document includes the text and images from the poster prepared by Jed Rothwell. The original poster is formatted for Super B paper, 13 × 19 inches.

Method of controlling a chemically-induced nuclear reaction in metal nanoparticles

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A pre-print of this paper is available at LENR-CANR.org:
http://lenr-canr.org/acrobat/MizunoTmethodofco.pdf
After the ICCF18 conference, Mizuno improved the calorimetry. A new version of the paper witn an Addendum was uploaded in November 2013

Excess heat is observed when nanoparticles of nickel or palladium undergo glow discharge electrolysis in hydrogen or deuterium gas. After glow discharge ends, when additional gas is admitted to the cell, another burst of heat is sometimes observed.

This method produces nanoparticles by bombarding the electrodes with electrons during ~30 hours of glow discharge. The nanoparticles are created *in situ* in electrodes. The electrodes have already been cleaned and purified, and they are kept in a high-purity gas environment, so the nanoparticles have little contamination on the surface and they are highly absorbent. With other methods, the nanoparticle material is fabricated elsewhere and exposed to air and contamination before being placed in the cell.

The particle size and number of particles is controlled by varying the strength and duration of initial glow discharge. This, in turn, controls the reaction rate.

In a typical run with a fine wire palladium electrode, the cell produced 4.4 kJ of anomalous heat at first. After polarity was reversed, making the electrode positive, 54 kJ more excess heat was produced. After glow discharge finished, 10 ml of additional deuterium gas was added to the cell, an extra 15 kJ of anomalous heat was produced.

Excess heat was produced in 25 out of 50 test runs.

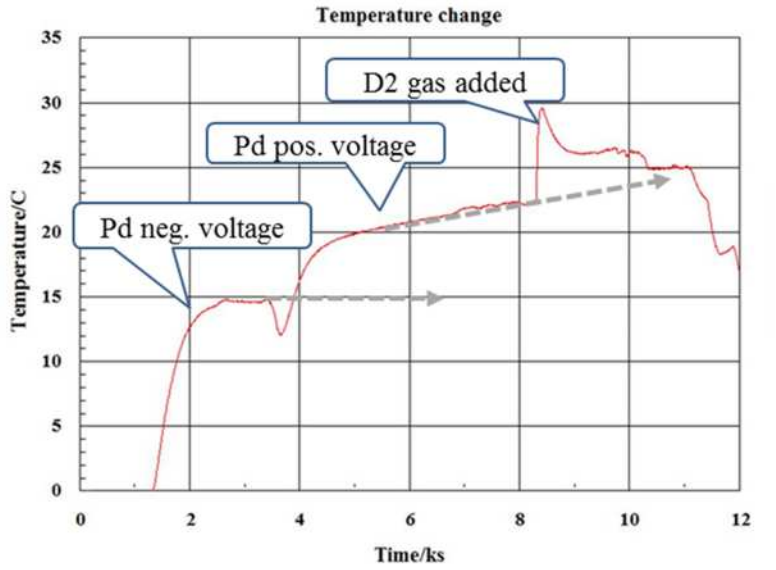

Figure 1. A typical run with fine wire palladium electrode.

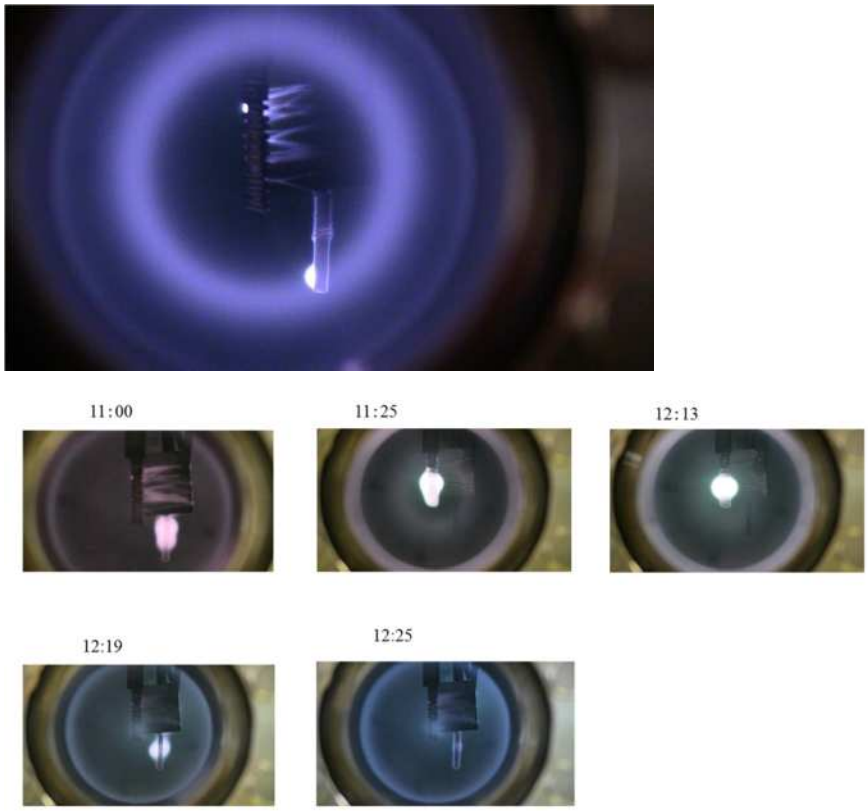

Figure 2. Glow discharge seen through cell window.

Reactor

The reactor vessel is made from SIS306 stainless steel, with a volume of 15 L, weight 50 kg. It is 500 mm tall, and about 500 mm wide. Electrodes are introduced from the top. There are a variety of connection terminals at the sides, including the gas inlet, pressure gauge and vacuum exhaust. A Kovar glass window on the side of the reactor vessel allows direct observation of the glow discharge conditions.

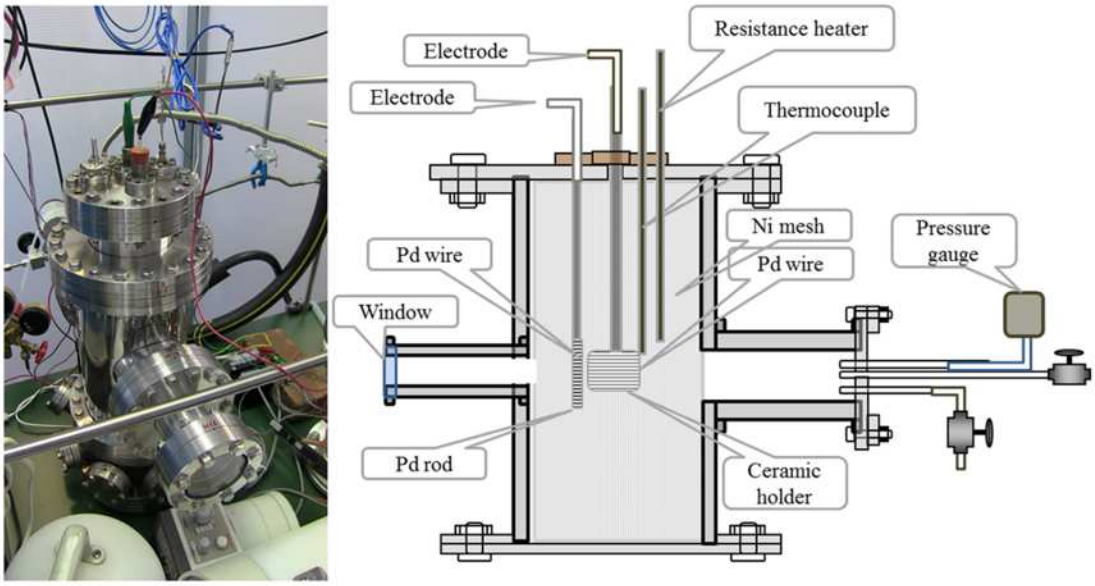

Figure 3. Schematic of reactor.

Electrodes

One electrode consists of a square alumina ceramic holder with palladium wire wrapped around it. The other is made with 300 mm of palladium wire wrapped in a tight spiral around a palladium tube, which is 50 mm long, 3 mm in diameter. The entire assembly is washed in alcohol and acetone, and kept clean thereafter.

The temperature of the electrodes is measured directly with a K-type thermocouple. It touches the surface of the electrode wrapped around the ceramic holder. There are two other thermocouples in contact with the outside surface of the reactor: one in the middle of the cell, and one at the base.

The wire electrode is subjected to about 30 hours of glow discharge, which creates nanoparticles on the wire surface. Because the particles are created in the clean, sealed cell, and loaded with hydrogen or deuterium as soon as they are created, contamination is kept at a minimum, and high loading is achieved.

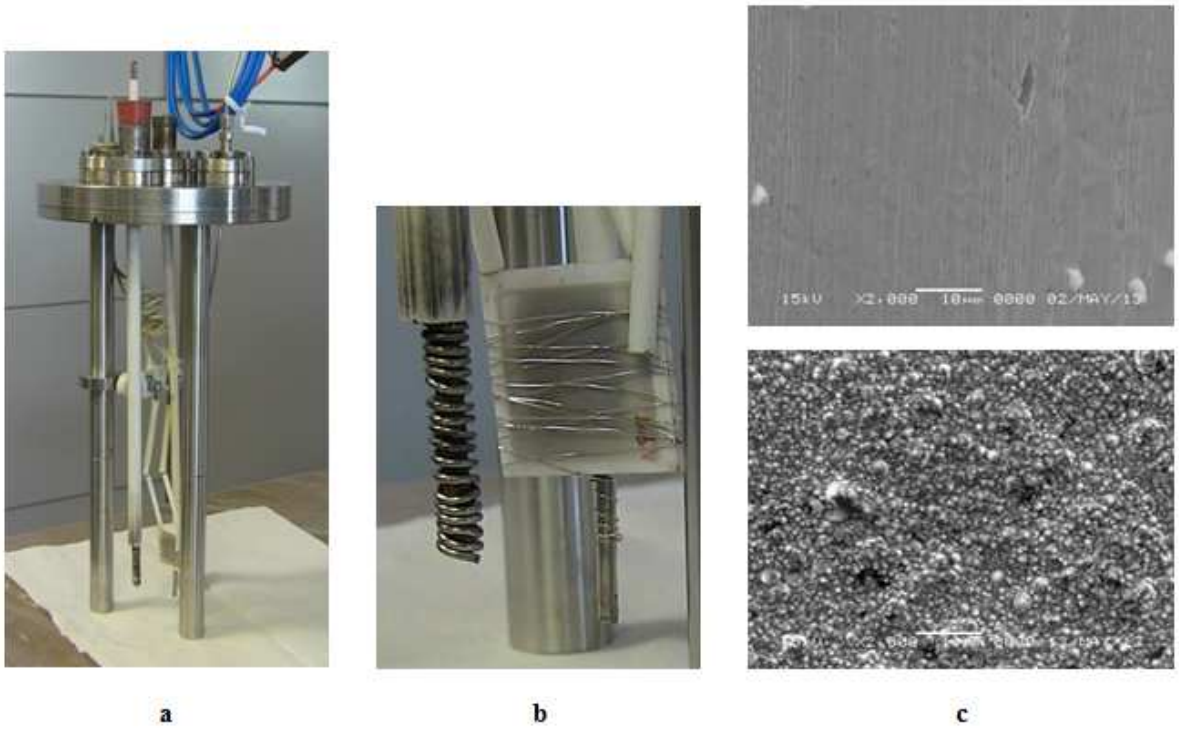

Figure 4. Electrodes. a.) Reactor lid with electrodes attached. b.) Close up of electrodes. c.) Nickel wire electrode surface before and after 30 hours of glow discharge, showing nanoparticles produced *in situ*.

D_2 gas glow discharge, July 5, 2013

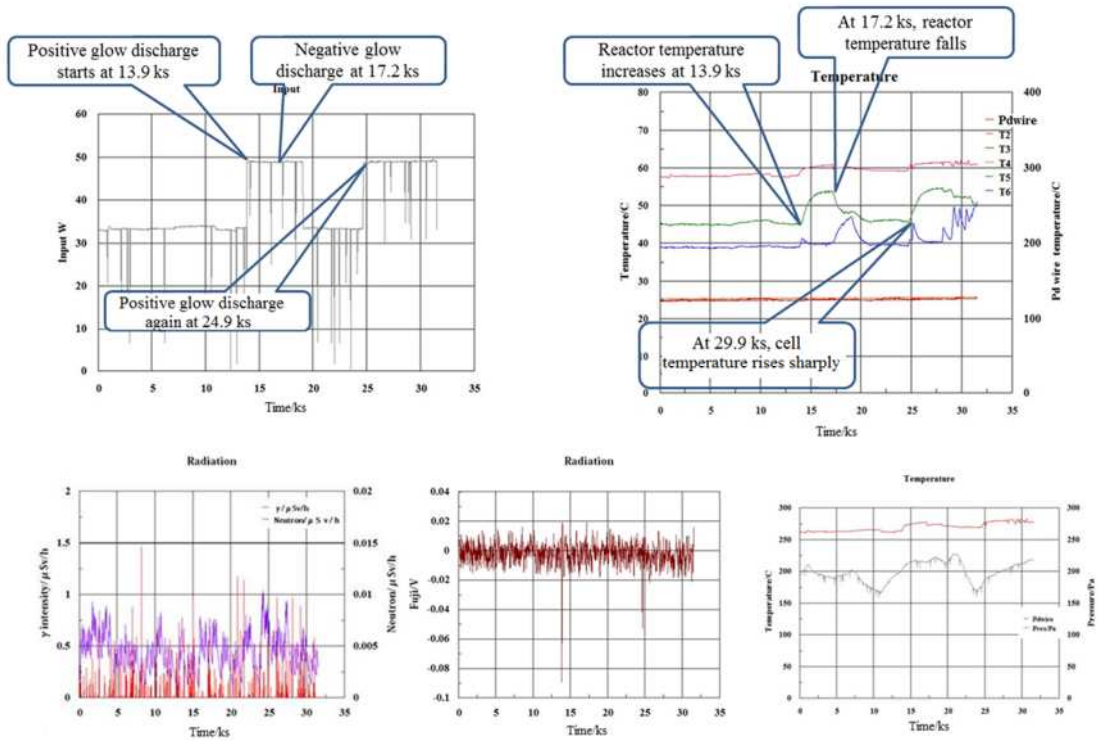

Figure 5. D2 gas glow discharge, July 5, 2013.

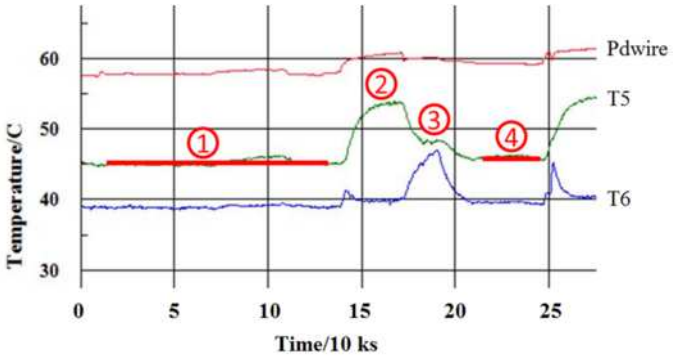

Figure 6. Detail from Fig. 5, D2 gas glow discharge.

Figure 6 shows a closer look at July 5 temperature data. The T5 thermocouple at the cell wall is shown: ① at baseline 33 W negative voltage glow discharge; ② 49 W positive glow discharge, with cold fusion anomalous heat; ③ 49 W negative glow discharge, no anomalous heat; ④ back to negative voltage 33 W (the baseline).

The electrode temperature (Pdwire) does not increase much when glow discharge power increases, as described in the next section.

Difficult Calibration

The cell is calibrated with the resistance heater, which is stepped through power levels from 5 to 45 W. The temperatures at the electrode surface are shown here for D2 gas and a vacuum. The response was nearly linear and close for both gas and a vacuum. However, this calibration with heating for the electrode is not an accurate method to determine the power level with glow discharge. The temperature does not respond to changes in power because the plasma transfers heat away from the electrode.

The temperatures at the cell wall (T5) and the base of the cell (T6) were also recorded, and these are the same for with resistance heating and glow discharge. In this study, power out is calculated as a function of T5 and T6.

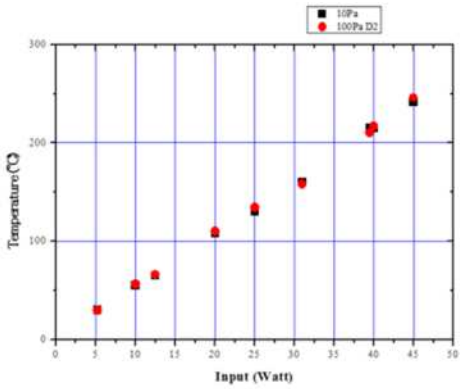

Figure 7. Electrode temperatures during calibration with resistance heater. Black squares, vacuum at 10 Pa; red circles, D_2 gas at 100 Pa.

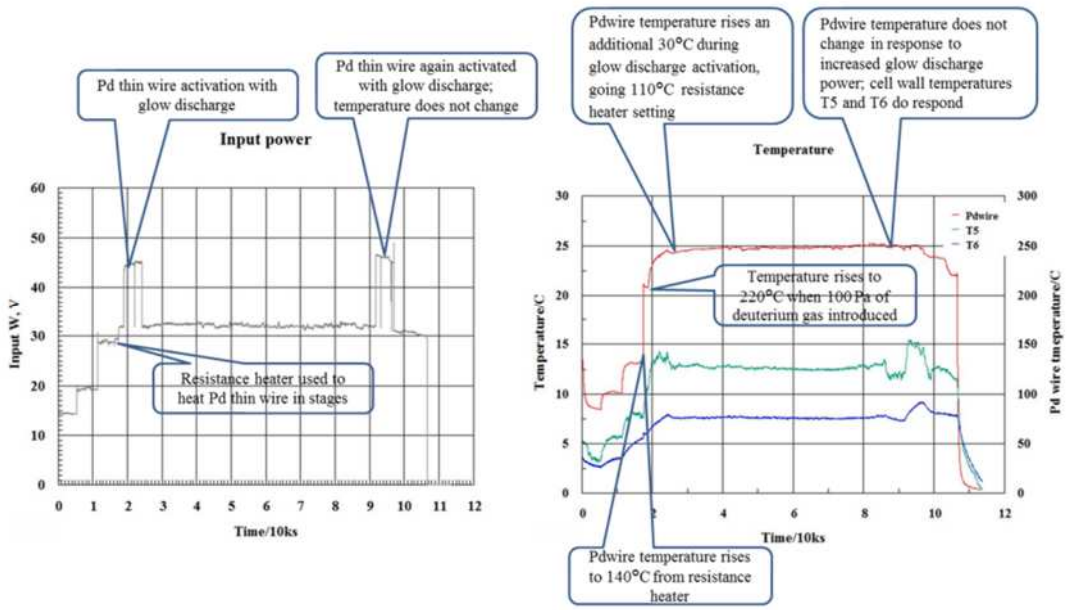

Figure 8. The electrode temperature (Pdwire) does not respond to increased glow discharge power, but the cell wall temperatures (T5 and T6) do.

Equipment

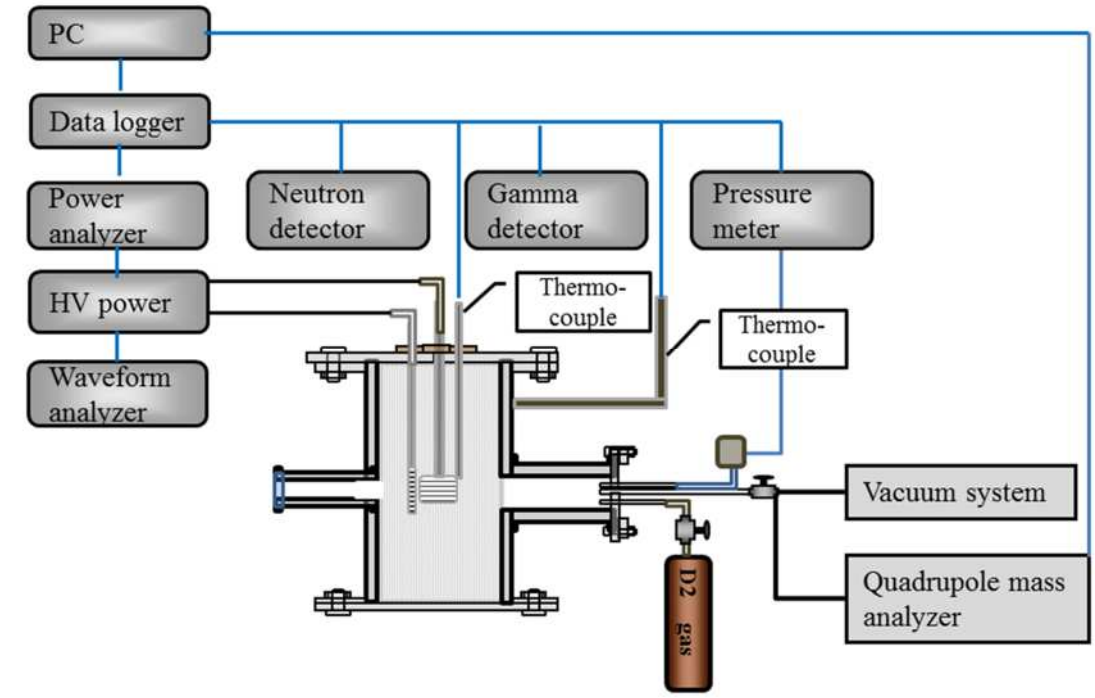

Figure 9. Schematic of equipment setup.

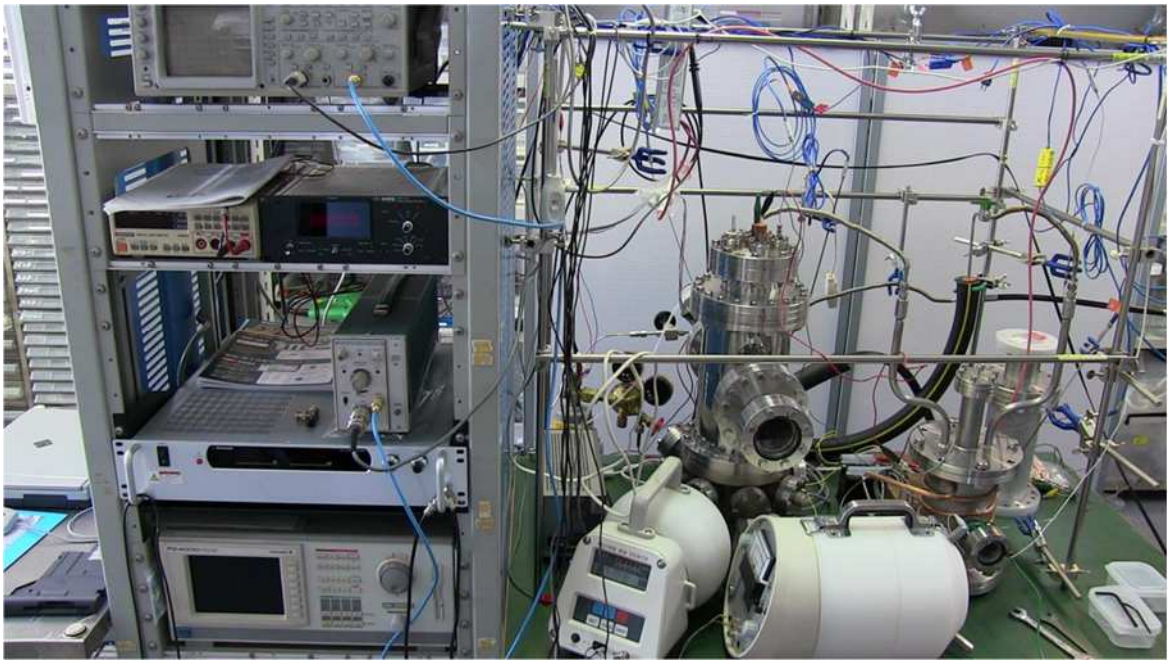

Figure 10. Equipment setup. Radiation detectors are in the foreground.

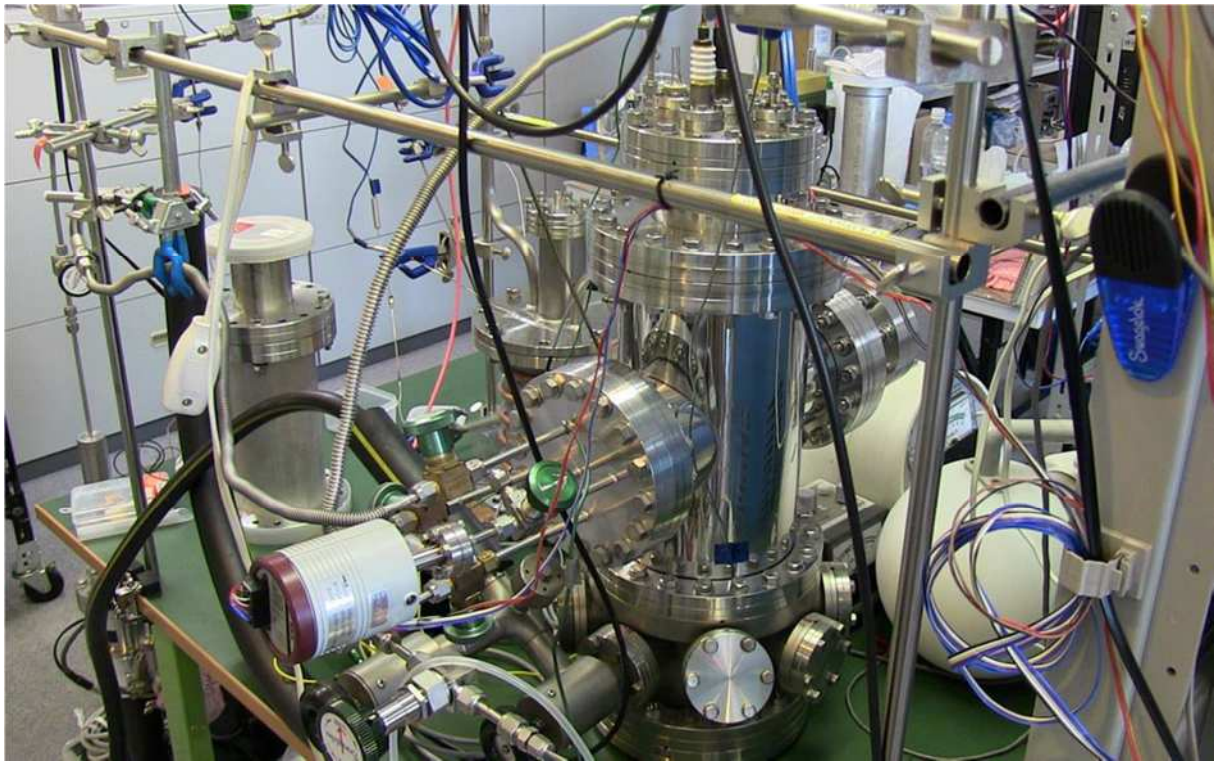

Figure 11. Reactor.

Figure 12. Quadrupole mass analyzer.