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Author
Rony, Peter R.

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Peter R. Rony

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Peter R. Rony†

Lawrence Radiation Laboratory and
Department of Chemical Engineering
University of California
Berkeley, California

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A Wrede-Harteck gauge (WHG) fitting has been constructed that differs in four important respects from the one described several years ago by Sharpless, Clark and Young:[1] (a) it is mounted separately from the pressure transducer; (b) it is water cooled; (c) its effusion-hole diaphragm can be easily replaced; and (d) it can be used with any differential micromanometer that has a small residual volume.

Shown in comparison to a non-water-cooled model in Fig. 1, it consists of a solid copper base with an O-ring groove, an electroplated nickel end, a water-cooled region containing two hose fittings, and a small glass ball joint glued to the base; a 1/2-mil thick Teflon effusion-hole diaphragm containing from three to two hundred 2-mil diameter holes; and a Teflon sleeve to clamp the effusion diaphragm tightly to the nickel-plated base end.

The fitting is clamped inside a "WHG port" constructed from a small segment of a No. 25 O-ring joint, a piece of capillary tubing, and a small glass joint (Fig. 2). The atoms within the low-pressure reaction system pass through a 3/16-in. port hole in the side of the Pyrex tubing into the WHG port chamber, where they are detected. The two O-ring grooves in the Teflon sleeve are not necessary. They were initially added to isolate the two sides of the differential micromanometer and to enable the WHG fitting to be easily interchanged among different WHG ports.

A differential micromanometer consisting of a commercial pressure transducer and a specially built electronics unit was capable of detecting 0.06% atomic hydrogen at 75 mtorr with this fitting.[2] With ten effusion holes and a residual volume of 10 cm^3 behind the effusion diaphragm, the response time was about 10 to 15 sec, a figure which can be lowered by almost a factor of ten by minimizing the residual volume.

The 2-mil diameter effusion holes were made with a jeweler's drill. The use of a high-intensity pulsed laser may provide a convenient method for producing these small holes in plastic films (covered with a removable opaque coating) and extending the WHG range to higher pressures.

For the steady-state measurement of atom concentration, the water-cooled feature of this fitting is very important; atoms recombining on the catalytic surface liberate considerable heat and produce thermal-effusion effects that detract from the stability of the output signal from the gauge.

The complete Wrede-Harteck gauge was used in the study of the kinetics of atomic hydrogen at low pressures. The results of these experiments and further details about the WHG fitting described in this note are given elsewhere.[3]

FOOTNOTES AND REFERENCES

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†National Science Foundation Predoctoral Fellow 1961-1964. Present address: Monsanto Company, 800 No. Lindbergh Blvd., St. Louis, Missouri.

1. Robert A. Sharpless, K C. Clark, and Robert A. Young, Rev. Sci. Instr. 32, 532 (1961).

2. Peter R. Rony, Lawrence Radiation Laboratory Report UCRL-11218, Pt. II, April 1965 (unpublished).

3. Peter R. Rony, Lawrence Radiation Laboratory Report UCRL-16050, April 1965 (unpublished).

FIGURE CAPTIONS

Fig. 1. Photograph of two Wrede-Harteck gauge fittings. The assembled fitting on the right is the water-cooled model finally used for experiments with atomic hydrogen. The non-water-cooled model pictured on the left has been disassembled to show the details of the Teflon effusion membrane, the Teflon sleeve, and the catalytic surface containing a pressure-bypass hole.

Fig. 2. Photograph of the two fittings mounted inside Wrede-Harteck gauge "ports". A small 3/16-in. hole in the side of the wall permits the sampling of atoms from the main cylindrical tube.

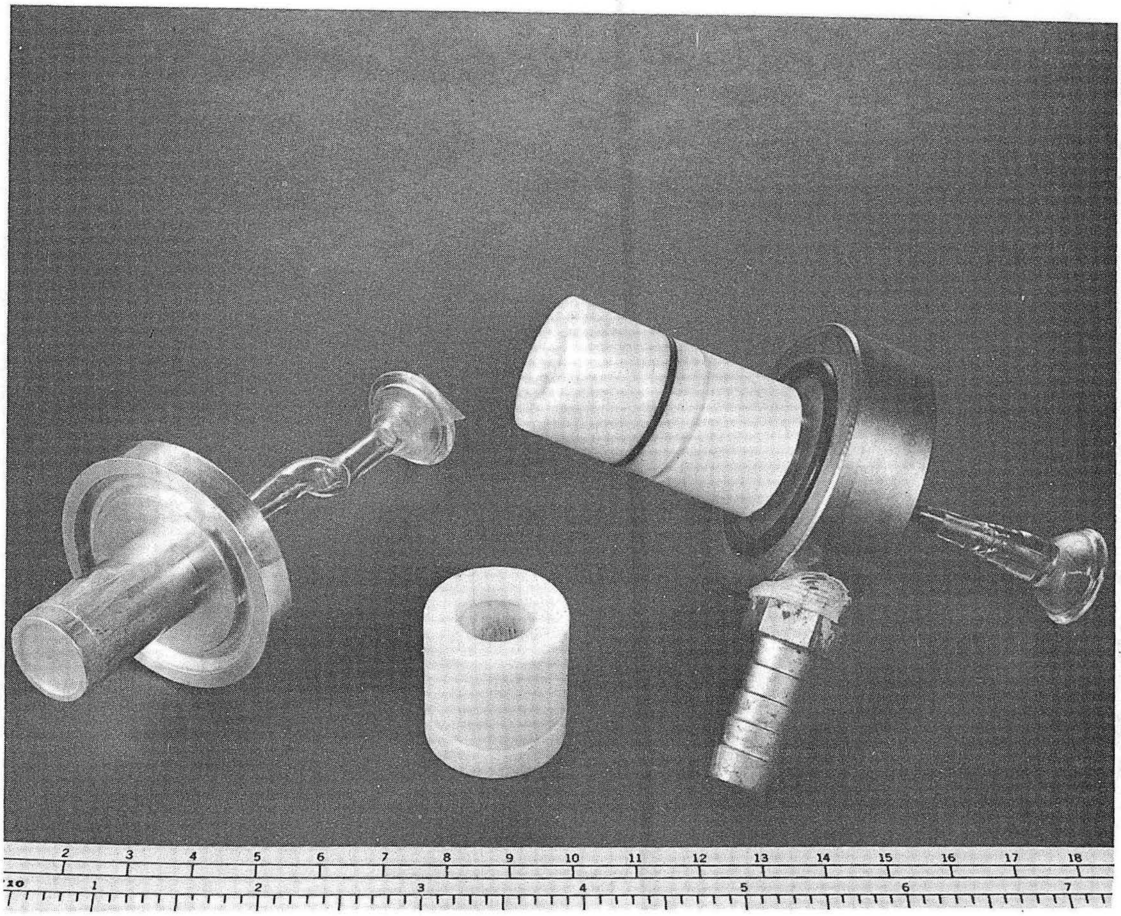

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Fig. 1

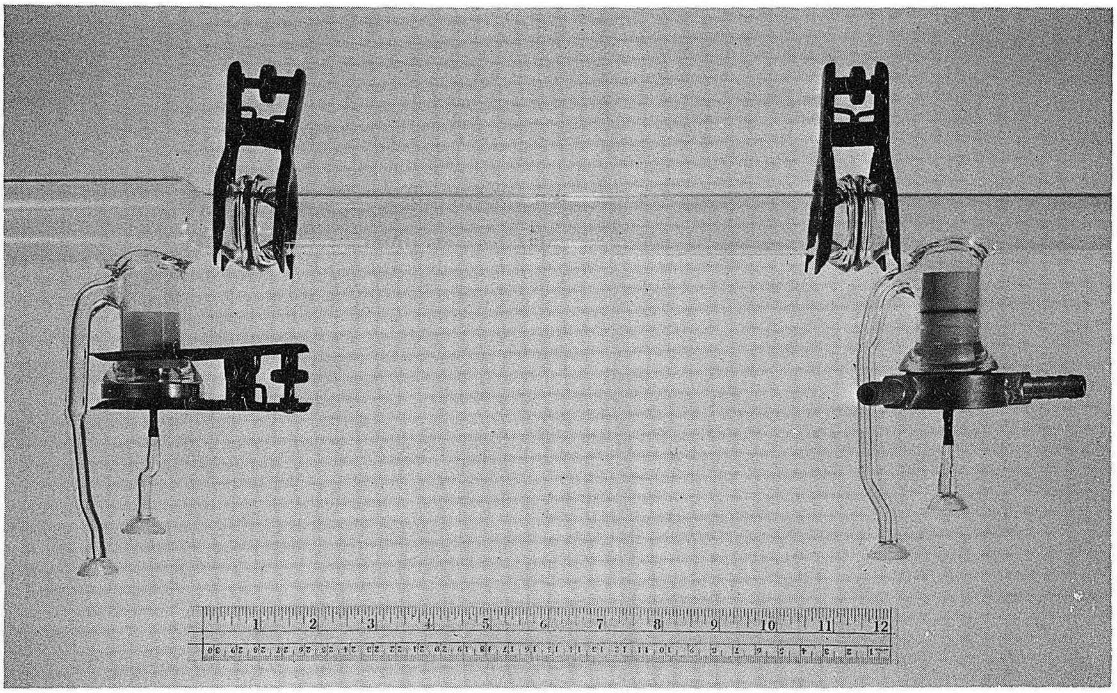

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Fig. 2