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Turbomolecular Pumping for Argon Extraction Systems

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ABSTRACT

A brief account is given of experiments with the turbomolecular TVS 250 Pfeiffer pumping group. Its advantages on other systems are complete independance of traps and a hydrocarbon-free background. Ultimate vacuum is about 10^{-9} mm Hg.

Diffusion pumps are yet the most used apparatus for argon lines. Their qualities are well known but some of their drawbacks are the necessity of traps and of an auxiliary pumping for preliminary evacuation. Ion pumps are also in wide use now but even for the most advanced models, they need preliminary pumping with zeolites. Neither systems can withstand accidental air inlet at atmospheric pressure.

One year ago we constructed an argon line with turbomolecular pumping. The features of the line are classical and designed after the indications of several authors. It is blown in 1 cm diameter Pyrex with all metal valves built by Radiotechnique-Philips. These valves have a 2 l/sec conductance and are bakable up to 450 °C, either shut or open. The line is made in two parts, the first with the RF heated furnace, the second with the purification system; each is provided with a separate pumping vent (2 cm diameter). The volume of the whole line is about 950 cm^3.

The pumping apparatus is the ARTHUR PFEIFFER Hochvakuum Technik model TVP 250. It comprises the TVS 250 turbomolecular pump, backed by a 3 m^3/h two stages oil rotary pump with the interposition of a vacuum valve, automatic air inlet and electronic units. The TMP is attached to the line through a stainless steel bellow and two metal valves in order to pump separately the two parts of the line.

Let us recall briefly the principle of the TMP. Mechanically it resembles the compressor of a gas turbine, and is a modification of the Gaede molecular pump. The Gaede pump uses with a very low efficiency the aspiration properties of a smooth cylinder rotating a few microns from an equally smooth stator, whereas the turbomolecular pump of Becker is based on the compression effect of a bladed disc moving about 1 mm apart from a stator with symmetrically oblique blades. The geometry of the stator and rotor discs determines canals where the gases are trapped, compressed, then repelled in the direction of the blades movement. The compression rate and the pumping speed are linked with the blades obliquity, the discs thickness and the rotation speed. Multiplication of the blades (40 for one disc) and of the discs in succession (19) give a very high compression rate and a high aspiration speed.

Two symmetrical rotors are mounted on the same shaft, with the pumping vent in the middle of them; the gas is rejected at the extremities where it is taken away by the fore pump. The rotation (35000 rpm) is supported by special bearings and obtained without mechanical means through an Hall effect motor without collector. Bearings are lubricated through a special system in order to prevent the admission of oil in the ultrahigh vacuum part of the pump. Starting at atmospheric pressure, first the fore-pump evacuates the system and the TMP is automatically switched on after a few seconds. Its own pumping begins at about 0.5 mm Hg; the pumping speed is then constant from 10^{-2} to 10^{-9} mm Hg, the optimal speed being obtained after 5 min due to the inertia of the rotor.

A big part of the efficiency is lost in the ducts and the line itself. Also, the pumping speed given as 70 l/sec at the TMP exit is lowered by the interposition of a grid protecting the blades from glass debris in case of break-down. However, the lowest pressure measured in the line about 1 m from the pump exit is 5×10^{-9} mm Hg. So we think that 10^{-9} mm Hg is really obtained on the TMP.

In comparison with other pumping systems, the qualities of the turbomolecular pump are:

1. Complete independance of any sort of traps: only cooling water (5 l/min) and mains (1 KVA) are required.
2. No protection is required against accidental air inlet. During an early night baking, a break appeared in the glass apparatus, and the TMP had to pump against the atmosphere for several hours. No trace of hydrocarbons coming from the fore pump were seen after that in the mass spectrometer. So the TMP is hydrocarbon free.

   In case water or mains fails, pumps stop, connection between the fore pump and TMP is cut and an automatic dry air inlet operates in order to prevent oil from the low vacuum part to come in the high vacuum part.
3. The pumping speed is constant from 760 mm down to the ultimate pressure of the system. The pressure falls down from 760 to 10^{-5} mm Hg in 5 min, to 10^{-6} mm Hg in 15 min with well baked samples.
4. Pumping speed is the same for various gases. Continuous monitoring on the MS of the residual spectrum of the argon line shows that argon, oxygen and nitrogen are very thoroughly pumped. Water vapour, observed at the m/e = 18 line shows the slowest diminution due to the adsorption of water on the inner walls. A slight baking of the line and the pump at 150 °C (heaters are provided with the TMP), makes water behave like other gases during pumping. Hydrogen also falls down a little slower than nitrogen, and it is believed to come from water cracking.
5. The only maintenance required is changing the oil of the high vacuum part every 6 months.

The only drawback of the TMP system, after 1 year experience seems to be the noise. Although it is much lower than that of the bigger PFEIFFER pumps, the slight whistling of the TMP is in the long range troublesome for some people. In fact, the fore pump is much more noisy than the TMP itself.

As the ultimate pressure attainable in the apparatus is defined by that of the fore-pump, it seems vacuum could get be ameliorated, even for this non expensive model.

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REFERENCES

Technical papers by A. PFEIFFER GmbH, Wetzlar, Western Germany.