PROBLEMS OF 10^{-11} TORR ORDER

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Recent years, the needs of the ultra-high vacuum of $10^{-11\sim12}$ torr increase for the accelerators as the storage and the heavy ion machines. It is difficult in its own way to apply UHV to the vacuum system of the accelerators. In TARN project[1,2], the required vacuum is demanded less than 1×10^{-10} torr according to keep survival rate of >90 %. Then, the condition for attaining the UHV is searched using the test stands and the vacuum system of TARN was constructed on the basis of the results by the preliminary experiments.

In order to keep the vacuum of 10^{-11} torr, the outgassing rate from the chamber walls must be reduced to minimum. Then, the vacuum system is fabricated with the organic free materials. This constitution is efficient for the high temperature baking. The typical residual gas spectrum applying the baking only at 10^{-11} torr order is shown in Fig. 1. The discharge cleaning processe is feasible techniques for the surface cleaning. The effect of the discharge cleaning is shown in Fig. 2. It is a distinct change at M/e = 16 peak after the discharge[3,4].

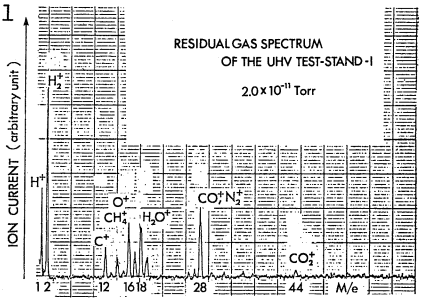

Fig. 1 Typical residual gas spectrum

The pumps and these combination for UHV must be chosen with due regard to the charactor of pumps. The oil free system is in dispensable to UHV. The pumping characteristics of turbomolecular pump toward hydrogen molecule was measured as Fig. 3. This result shows that the choice of the foreside pump of the turbomolecular pump is very important because the partial pressure of the hydrogen molecule at UHV region is dominant as will known. The diffusion pump which has high pumping speed about hydrogen molecules is applied as the foreside pump of turbomolecular pump in the case of TARN. Moreover, it is an effectual method in order to decrease the conductance to set the distributed pump as Fig. 4 in magnetic field.

Reference
1) Y. Hirao et al., NUMATRON, INS-NUMA-5, 1977
2) T. Katayama et al., NUMATRON and TARN, INS-NUMA-17, 1980
3) P. A. Redhead, J. Vac. Sci. Technol, 7 (1970) 182
4) R. Calder et al., Cleaning and suface Analysis of Stainless Steel Ultrahigh Vacuum Chambers by Argon Gas Discharge, private communication.

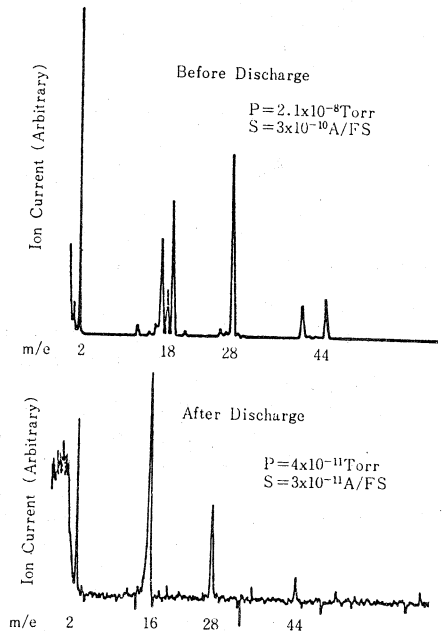

Fig. 2 The change of residual gas component after and before the discharge cleaning process

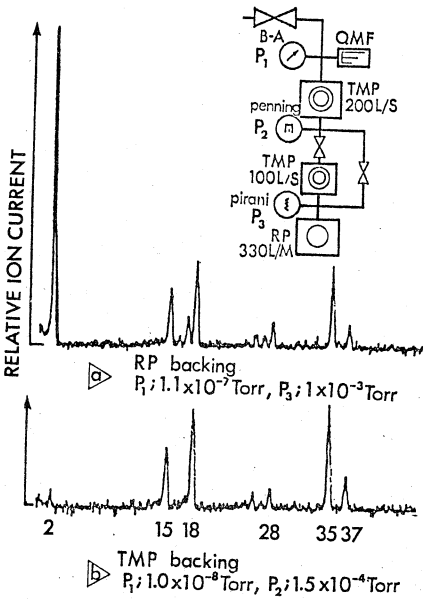

Fig. 3 The pumping characteristics of TMP toward H_2 molecules

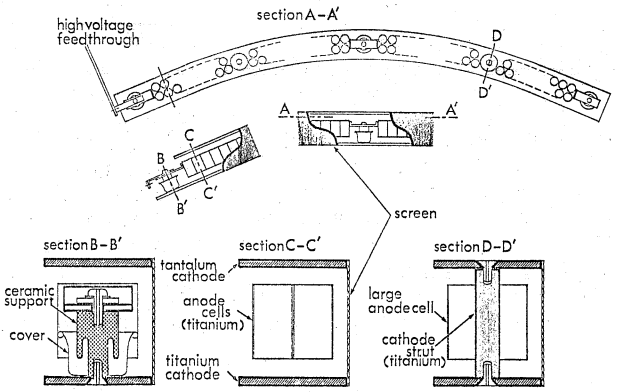

Fig. 4 The distributed pump in the bending magnet of TARN