Fig. 8. Spectrum of residual gases.

およぼわずかの 15, 16 であり、その他の成分は全くみとめられない。二次電子増倍管を用いて分析すると **Fig. 8** のように他の成分もかなり多いことがわかる。上記 N_2 , CO , Ar , CH_4 , CO_2 のほかに H_2O と C_1 , C_2 , C_3 , C_4 グループの炭化水素がみとめられた。イオンポンプを停止すると残留ガスは増大するが、 N_2 , Ar , CH_4 のピークの増加は顕著であり、他の炭化水素、 H_2O などはあまり増加しない。一般的にわれわれの分析計は炭化水素の成分が少なく微量ガス分析用

として有利であるが、これはイオンポンプを使用したためというよりもむしろ完全にベークアウトできるためであると考えられる。

6. む す び

実験中の超高真空質量分析計について構造の概要と実験結果の一部を説明した。今後検討すべき問題点として、

- (1) ガasket部分を改良してリークを $1 \times 10^{-9} \text{cc/sec}$ 以下とする。
- (2) コンダクタンスの大きい金属バルブを製作すること。以上の点は現在改造中である。さらに
- (3) 二次電子増倍管の電極処理法を検討し、利得を高めること。
- (4) 実際に ppm の桁の微量不純物を分析して性能を検討すること。

などの点については今後も研究をつづけたい。

現状で 10^{-9}mmHg の桁で一般ガス分析に用い得ることおよび $10^{-6} \sim 10^{-7} \text{mmHg}$ の桁で静作動分析が行えることが一応たしかめられている。

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On the Defect of Peak Shape in Mass Spectrum

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This paper describes the calculation of the deformed peak shape in mass spectrum.

Sometimes the top of the peak in mass spectrum is inclined and a swelling appears on the skirt of the peak. Assuming that a main ion beam accompanied with a weak beam enters into an ion collector, the deformed peak shape can be expected from calculation.

1. Introduction

Peaks in mass spectrum normally have flat tops

parallel to the base line, but sometimes the top is inclined and a swelling appears on the skirt of the peak as the right peak in **Fig. 1**. Though the complete explanation of this phenomenon is difficult

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and remains to be further studied, the deformed peak shape similar to that shown in **Fig. 1** is expectable when a main ion beam accompanied with a weak beam enters into the ion collector. The peak shape in case of double-beam is calculated in this paper.

2. Calculation of peak shape

The intensity distribution of a normal ion beam on the collector slit plane is not definite and a certain assumption is necessary. It is assumed in this paper that the ion beam whose intensity distribution is represented by Gaussian error function is scanned across the collector slit. Then, the peak shape for a single beam is given by

$$\left. \begin{aligned} I &= \frac{1}{2} \left\{ \phi \left(x + \frac{\lambda}{2} \right) - \phi \left(x - \frac{\lambda}{2} \right) \right\} \\ \text{and} \quad \phi(\xi) &= \frac{2}{\sqrt{\pi}} \int_0^{\xi} e^{-t^2} dt, \end{aligned} \right\} \quad (1)$$

where λ corresponds to the slit width.

If there are two beams and one of them comes close on the heels of the other, the peak shape to be obtained is given by

$$\begin{aligned} I &= \frac{\alpha}{2} \left\{ \phi \left(x + \frac{\lambda}{2} \right) - \phi \left(x - \frac{\lambda}{2} \right) \right\} \\ &+ \frac{\beta}{2} \left\{ \phi \left(x + \frac{\lambda}{2} - s \right) - \phi \left(x - \frac{\lambda}{2} - s \right) \right\} \end{aligned} \quad (2)$$

where s is the separation of the beams and α/β is their intensity ratio.

Some curves calculated from Eq. (2) are illustrated in **Fig. 2**. The figure shown in **Fig. 2c** has a resemblance to the deformed peak in **Fig. 1**.

3. Conclusion

The deformed peak shape as shown in **Fig. 1** does not necessarily depend on the double-beam, but the double-beam in some condition is sure to cause such a deformed peak.

The ion optical system of the mass spectrometer is,

for example, shown in **Fig. 3**. Some of ions may be reflected at an edge of a slit and cause one or two subsidiary effective ion sources which produce multiple-beam. Anomalous ions such as metastable ions which enter the collector closely to the main beam in question may be another origin of the deformed peak.

In practice, the deformed peak is observed frequently when there exist metastable ions. The deformed peak also appears in case of wrong adjustment of ion accelerating system and disappears by the correction of adjustment.

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Fig. 1. An example of observed mass spectrum.

Fig. 2. Calculated peak shape from Eq. 2.
 $\alpha=0.9$, $\beta=0.1$, $\lambda=6$
 (a) $s=0$, (b) $s=-2$, (c) $s=-3$,

Fig. 3. Schematic diagram of ion optical system in the mass spectrometer.