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SHORT NOTES**Stabilization of the Filament Temperature
for Surface Ionization**HIROHIKO EZOE*[†] AND YOSHIKO ITOH*

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It was observed¹⁾ that the ion current of K^+ emitted from the KCl sample coated on a hot tungsten filament varied elusively owing to the temperature variation of the filament caused by the fluctuation of the heating current, and presumably to the complicated behavior of the sample atoms and ions on the hot surface. It must also be taken into account that the residual gases in the ion source would have influence on the ion emission even when the vacuum was of the order of 10^{-7} Torr. Thus, since there will be several causes involved, it is necessary to separate them individually in order to analyze the irregularity of the ion emission from a hot filament. First of all, the extrinsic and undesirable temperature variation of the hot filament has to be eliminated as it may affect seriously on the ion emission. This does not imply, however, to intend to stabilize the whole ion current. The emitted ion current can be stabilized by a conventional feedback method, but it will then tell nothing more about what will have occurred on the filament surface.

Different methods can be applied to stabilize the filament temperature, but an attempt was made to do this by means of regulating the electron current emitted from the same filament on which the sample KCl was coated. The tungsten filament used was a ribbon of 0.75 mm in width, and the sample was coated on the surface faced to the exit slit of the ion source, while the back surface was left clean and the electron current emitted from this side was collected to a separate electrode and regulated through a conventional emission regulator circuit of a mass spectrometer for gas analyses. This idea can be applied in a modified way by collecting the electrons emitted from a separate portion of the filament in the ion source provided the temperature is the same as that of the portion where the sample is coated and, in practice, when the ion source has enough room to equip a longer filament and an excess electrode. The proposed idea is not effective, of course, when the work function of the filament varies by some causes other than the temperature variation, but fortunately this

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Fig. 1. Ion source used. F: Filament for surface ionization, C: Electron collector, E.R.: Emission Regulator.

will not almost be the case for pure metals when the surrounding vacuum is kept high enough.

Figure 1 is the sketch of the ion source used¹⁾. The electrode which was kept positive with respect to the filament to collect the emitted electrons was expected to be a repeller

for the positive ions, but so far as we tried it worked almost wrong. The recorded mass spectrum of K^+ varied sensitively with the dimension and location of this electrode and often it was distorted and diminished badly. Hence, the way which we chose finally was to make the positive electrode have little effect on the ion current by employing a fine tungsten wire of 0.1 mm in diameter and fixing it close to the ribbon surface and out of the ionization chamber. It may not be hopeless, however, to let this added electrode be a repeller if it is formed in a shape to cover the ionization filament from behind.

The results are shown in Fig. 2. The power supply used always for the hot filament was a commercial a. c. voltage stabilizer of the working range of 100 ± 1 volts. It is seen that the short term fluctuations of the ion currents were almost eliminated when the emitted electron currents were regulated and kept nearly constant.

The more careful work should be done, but the present idea may be useful for the study on the intrinsic irregularity of the surface ionization. The advanced results may be reported elsewhere.

Fig. 2 (a)

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Fig. 2 (b)

Fig. 2 (c)

Fig. 2. Regulated and unregulated ion current I_i of K^+ .

- (a) Short time after the filament current I_f was applied.
- (b) Long time after the filament current I_f was applied.
- (c) Filament current I_f was changed.

Reference

- 1) H. Ezoe and Y. Itoh, *Mass Spectroscopy (Japan)*, **20**, 357 (1972).