NOTIZEN

Improvement in Focusing of a Mass Spectrograph with Large Dispersion

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(Z. Naturforschg. **21 a**, 1304 [1966]; received 31 May 1966)

The focusing characteristics of the high dispersion mass spectrograph at Osaka University has considerably been improved. The distinguishing features of this apparatus is that the mass dispersing action of a r^{-1} magnetic field is utilized. The apparatus has a r^{-1} magnetic field of 198.1° sector type (22 cm mean radius) as the dispersing field, a toroidal electric field of 118.7° (30 cm mean radius) and a 30° uniform magnetic field (120 cm mean radius) as the focusing fields. The total ion path is about 6.5 m. The principle, the design and the construction of the apparatus was described previously [1]. The parameters of the apparatus are shown in Fig. 1 of ref. [1].

As already reported, in the preliminary experiment, the dispersion on the photographic plate was estimated to be about 14 cm for 1% mass difference and the agreement with the calculation was satisfactory, but, the spectral lines were considerably curved. Recently this curving effect has been removed. The cause of this effect has proved to be a slight magnetization of the slit which restricts an ion beam in the dispersing magnetic field. A movable slit as shown in Fig. 1 was placed in the dispersing magnetic field near the entrance and was adjusted so that the ion beam was passing through the rectangular hole. If it is slightly magnetized by a magnetic field of about 5000 gauss and the magnetic field near the upper and lower ends of the hole is increased by about 50 gauss as compared with that near the center over a region of slit thickness, say about 1 mm, then the difference between the lateral position of the center beam and that of the end beam is estimated to be about 0.16 mm at the image point. This makes the spectral lines considerably curved. Formerly, the slit was made of 18-8 stainless steel (JIS SUS 27) sheet and was slightly magnetized unfortunately. It has been replaced by a non-magnetic material (Mo), and the curving effect has been removed.

Further improvements in the sharpness of the spectral lines have been accomplished in the following way.

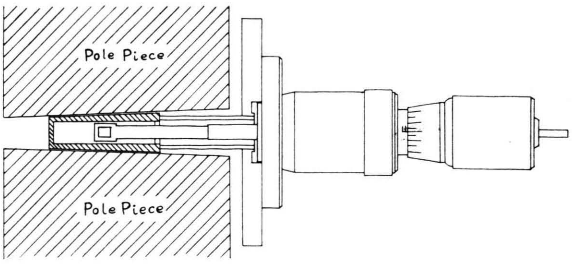


Fig. 1. Movable slit in the dispersing magnetic field. Slit hole dimension: 4 mm × 5 mm.

Two origins of broadening spectral lines were found out. One is vibrations due to mechanical pumps and the other hum magnetic fields. In order to reduce the stray magnetic field, a number of iron sheets are placed near the magnets. Small vibrations of these sheets caused by the motion of mechanical pumps disturbed magnetic fields considerably. In order to reduce this effect, mechanical pumps have been replaced by sorption pumps during exposures. A considerable 60-cycle hum magnetic level is found in the laboratory where the mass spectrograph is constructed. Even if there is no exciting current, the magnets catch a few milli gauss of hum magnetic flux. In order to reduce the hum magnetic field, a negative feedback method is adopted. The output of a pick up coil of 75 turns which is wound around the magnet pole piece is amplified, phase-inverted and supplied to a feedback coil of 5 turns. The hum magnetic field in the pole gap is reduced to about one fourth by this device. Also the beam duct outside the magnet is covered by permalloy sheets 0.2 mm thick in order to reduce the hum magnetic stray field.

Fig. 2 * shows the spectral lines of artificial doublets thus obtained. Thermal ions of potassium 39 accelerated to about 14.5 kV are focused on the photographic plate. When exposures are made, the potentials applied to the condenser electrodes and also the accelerating voltages are slightly shifted for each successive exposure while keeping the magnetic fields constant. The shifted potential was about 1.1 volt. The three spectral lines in Fig. 2 are considered to correspond mass numbers 1774, 1775 and 1776 respectively. The distance between lines is about 9 mm, and the line width is measured to be 12 microns, so that the resolving power is estimated to be about 1 200 000.

The authors wish to express their thanks to Prof. K. Ogata for his valuable discussions.

[1] H. Matsuda, S. Fukumoto, Y. Kuroda, and M. Nojiri, Z. Naturforschg. **21 a**, 25 [1966].

* Fig. 2 on p. 1304 a.

H. Matsuda, S. Fukumoto, T. Matsuo, and M. Nojiri, *Improvement in Focusing of a Mass Spectrograph with Large Dispersion (S. 1304).*

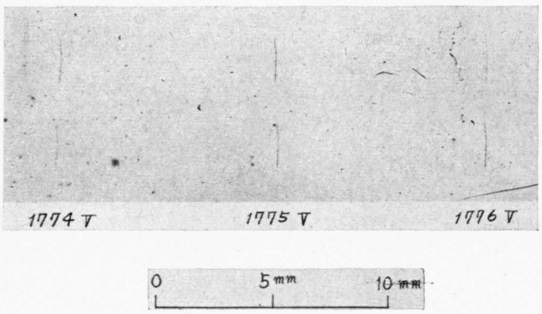


Fig. 2. Example of improved mass spectral lines.

H. EBEL und W. HELDMANN, *Eine große Seemann–Bohlin-Kamera (S. 1305).*

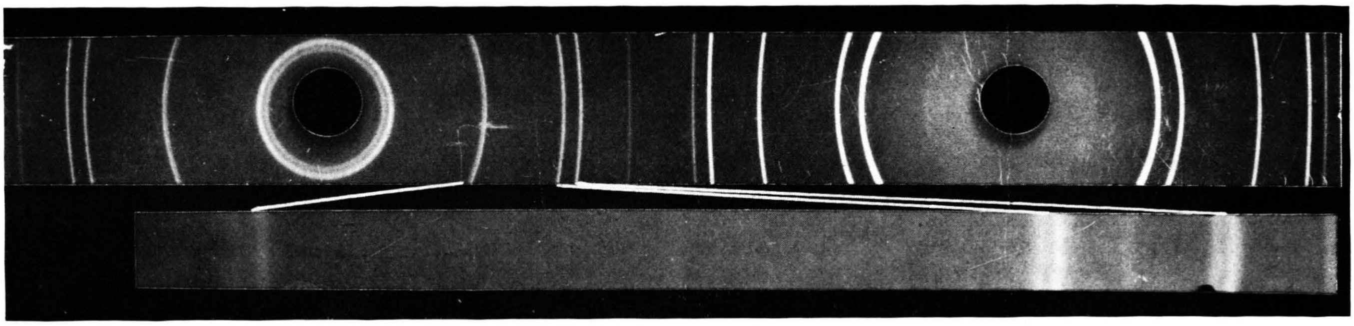
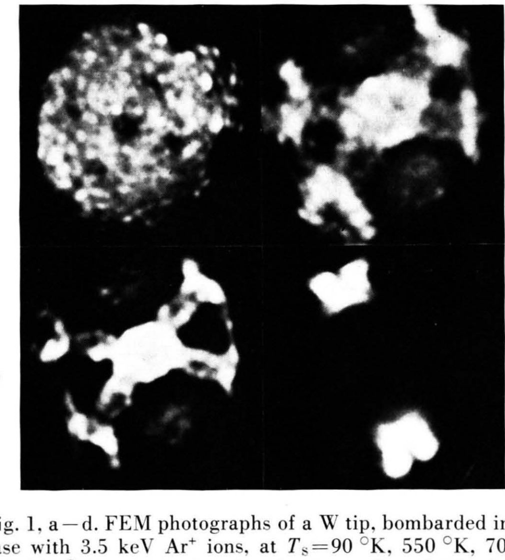


Abb. 2. Vergleich einer normalen DEBYE–SCHERRER-Aufnahme mit einem Filmausschnitt der SEEMANN–BOHLIN-Aufnahme (Reinstaluminium, Kupfer-K-Strahlung).

H. VERNICKEL, *Influence of Surface Defects on Sputtering (S. 1308).*



a) b) c) d)

Fig. 1, a – d. FEM photographs of a W tip, bombarded in each case with 3.5 keV Ar^+ ions, at T_s=90 °K, 550 °K, 700 °K, and 800 °K respectively. (Bombardment lasted 10 min with approx. 10^{14} ions/cm^2 sec.)