Oskam, H. J.
Jongerius, H. M.
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LETTER TO THE EDITOR

Helium-neon bands

For the first time helium-neon was mentioned by Druyvesteyn[1]) in a letter about helium-neon bands in the violet region of a gas discharge spectrum. Weizel[2]) has doubted the existence of these bands. However, recent measurements of a totally different character in gas discharges of a special kind done by Oskam [3]) and by Pahl [4]) indicate the appearance of the HeNe molecular ion. To confirm this we have repeated the measurements of Druyvesteyn.

For this purpose we have photographed the 7000—3600 Å range of the spectrum of discharges in helium and neon separately and also in a mixture of the two gases. One half of a double discharge tube (fig. 1) was filled with helium of 10 mm pressure, the

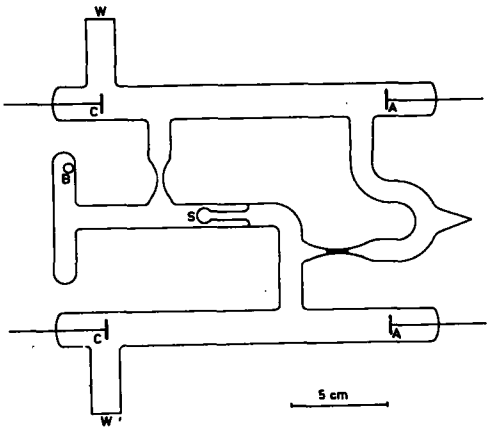

Fig. 1. The double discharge tube, in upper view. At first one half is filled with helium, the other with neon. Later on the two gases are mixed by breaking the glass seal S by means of the steel ball B. The negative glow is viewed via windows W, which are not reached by the cathode sputtering. Cathode C and anode A are flat electrodes of molybdenum.

Tube and electrodes are thouroughly degased before melting off. The noble gases used were very pure (contamination less than 1 to 10^7). In the spectrum we found no other lines than those of the noble gas and of the electrode metal.

other half with neon of the same pressure; for the helium-neon experiment the gases could be mixed by breaking a seal. Both before and after breaking the dividing seal exposures were made of the positive and the negative glow by means of a medium size glass spectrograph. The three exposures of fig. 2 refer to the same spot in the tube, about 3 mm behind the cathode.

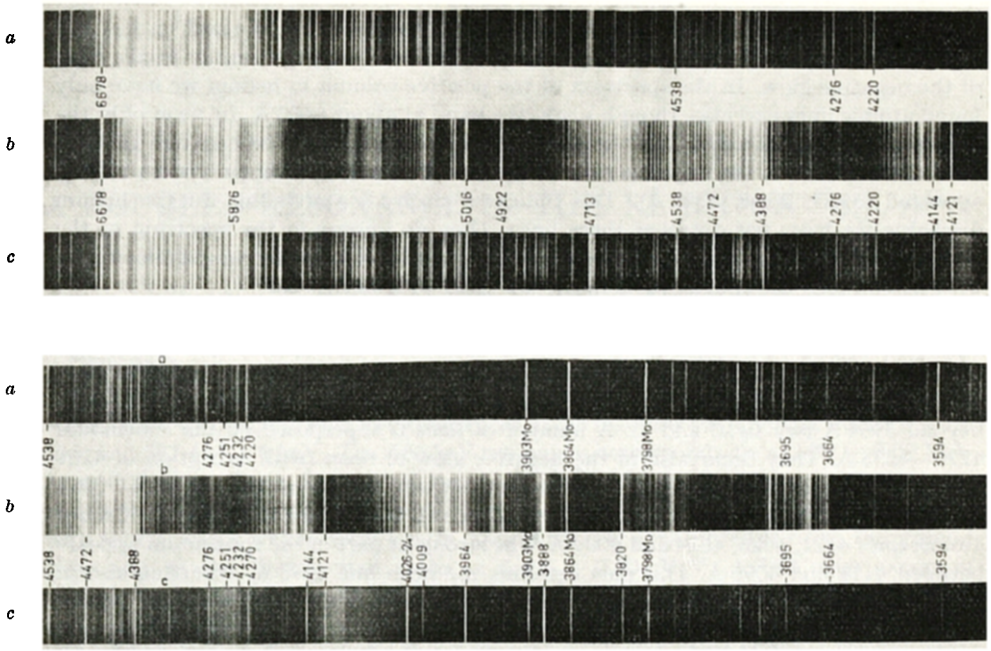

Fig. 2. Spectrum of the negative glow of neon (*a*), helium (*b*), and the mixture (*c*). Exposures on Ilford HP_3 plate. Exposing time 2 hours. Medium size glass spectrograph. Current 10 mA. Gas pressure 10 mm.

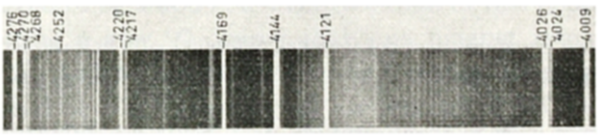

Fig. 3. Spectrum of the negative glow of the helium-neon mixture, between 4280 and 4020 Å. Exposure on Ilford HP_3 plate. Exposure time 20 hours. Medium size glass spectrograph. Enlargement 4 times the original exposure. Current 10 mA. Gas pressure 10 mm.

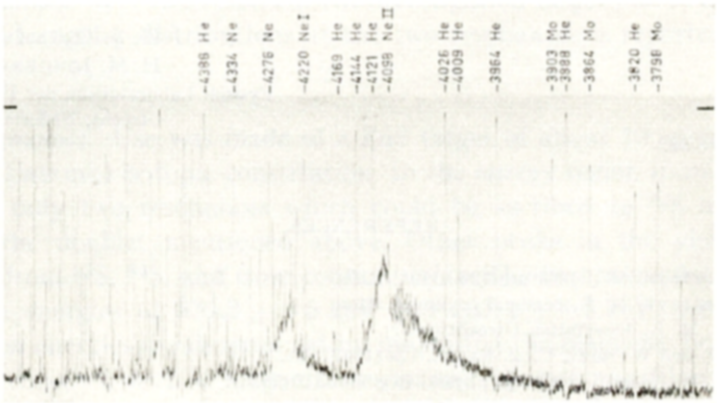

Fig. 4. Micro-densitometer curve of the spectrum of a mixture of helium and neon. An Ilford HP_3 plate had been exposed during 2 hours. Current 10 mA. Gas pressure 10 mm.

At this place the helium molecule spectrum (described by Weizel [5])) has the highest intensity. Obviously the helium molecules (ions?) appear mainly at the edge of the negative glow. In the spectrum of the positive column in helium we have only found atomic lines and also, though weak, the band at about 6400 Å. In neon only the line spectrum was detected, both in the positive column and in the negative glow. It is remarkable that in the negative glow of the neon discharge strong molybdenum lines appeared (3903; 3864; 3798 Å). This indicates electrode sputtering. In the helium discharge we have not detected these lines. They do appear in the spectrum of the helium-neon mixture. This agrees with the results of sputtering measurements [6]): with helium ions the sputtering is much less than with neon ions.

In the gas mixture the edge of the negative glow is violet. The spectrum contains atomic lines of helium and neon, but not the helium molecule spectrum. Moreover we have found two continuous parts (unresolved bands?) in the spectrum, not appearing in helium or neon. They extend from 4270 Å to beyond 4235 Å and from 4144 Å to beyond 3964 Å (see fig. 3 and 4). A number of lines is superposed on the continuum 4270—4235 Å. They occur also in the negative glow of neon (with exception of 4261 and 4235 Å which only appear in the mixture spectrum). In the continuum 4144—3964 Å one can distinguish a few different parts (bands?). Superposed on it are the helium atomic lines 4121, 4026, 4024 and 4009 Å. The strongest part of the continuum appears between 4114 and 4096 Å. This part contains the neon line 4098 Å, occurring also in the spectrum of the neon discharge. From 4096 to 4063 Å about 13 lines can be observed in the continuum, which is weaker in this region. The most distinct line appears at 4074 Å; it was not possible to determine the origin of these lines (band structure?). In the neon discharge spectrum only two are visible: 4070 Å and 4063 Å. From 4063 Å on the continuum becomes weaker in the direction of shorter wavelengths. However it certainly extends beyond 3964 Å. Increasing absorption in the spectrograph is a cause of intensity loss in this region. Fig. 4 shows a record of the helium-neon negative glow spectrum between about 4600 Å and 3800 Å. The two continuous parts of the spectrum are clearly visible.

Summarizing we conclude that the exposures confirm the existence of a helium-neon compound at the edge of the negative glow.

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H. J. Oskam
H. M. Jongerius.
Fysisch Laboratorium der Universiteit,
Utrecht, Nederland.

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