AN APPLICATION OF THE VACUUM TUBE OSCILLATOR

By C. B. Crofutt

A sustained source of sound is frequently desirable in certain experiments. The vacuum tube oscillator can be made to meet this requirement. When the metal rod in the Kundt's tube is replaced by the loud speaker of the vacuum tube oscillator, exceptionally good dust figures are obtained. The striations stand out with startling distinctness, the individual dust particles remaining suspended almost motionless in the gas. This may be used as a lecture demonstration or used in the laboratory, where a number of experiments will suggest themselves to the reader.

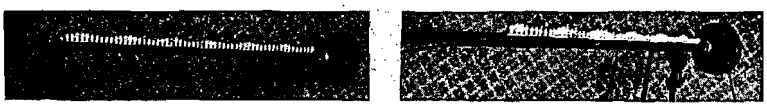

Fig. 1. Fig. 2.

Figs. 1 and 2. *Photographs showing wave form assumed by flames.*

For lecture purposes it may be desirable to replace the glass tube with a brass tube having a row of small holes spaced about one-half inch apart along the tube to serve as gas jets. It is well to cover the end of the tube next to the loud speaker with rubber dam to prevent the escape of gas. If gas is fed into the tube and the row of gas jets lighted, the flames assume a wave form when the tube is in resonance, as shown in the photographs.

The vacuum tube oscillator used by the writer was built for general laboratory use and covered a frequency range from 200 cycles per second to 1,500,000 cycles per second. The Hartley circuit was used, with honeycomb coils for the inductances. For radio frequencies a variable air condenser was used. For audio frequencies a mica condenser built especially for the purpose was connected in parallel with the air condenser. The steps on the mica condenser were of such magnitude, as compared with the variable air condenser, that any capacity from the minimum of the air condenser to two microfarads could be obtained. By proper choice of capacity and honeycomb coils any desired frequency could be obtained. The tube used was the UX 112; however, it might be well to substitute a power tube. Connection was made to the loud speaker by means of a small audio transformer placed in the plate circuit.

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THE L ABSORPTION LIMITS OF TUNGSTEN: PHOTOMETRIC MEASUREMENTS

By C. B. Crofutt

Abstract

In a previous paper both the absorption and emission spectra of tungsten were photographed simultaneously on the same plate. It has since seemed advisable to make a photometric analysis of the original plates showing the L absorption bands. The results give for L_1, 1.2117A, and for L_2, 1.0708A, as compared with the former eye measurements of 1.2122A and 1.0716A, though the last are regarded by the author as more reliable. The mean variation in the measurements is less than .0002A. L_1 is clearly between β_5 and β_{10} and L_2 between γ_6 and γ_2, indeed between γ_6 and a new line, 1.0699A.

IN A previous work[1] both the absorption and emission spectra of tungsten were photographed simultaneously on the same plate. Because accuracy in the measurement of the absorption limits is important, it seemed advisable to measure them on the original plates by means of photometric curves.

The photomicrograph[2] used was built and used at the University of Iowa. A complete description will be published later. Briefly it consists of a suitable lens system whereby a narrow beam of light (from .06 mm. to .12 mm) can be passed through the photographic plate and allowed to fall upon one junction of a thermocouple connected to a sensitive galvanometer, the deflection of which is a measure of the transparency of the plate.

It soon developed that, while the plates appeared very good to the eye and under low magnification, they were not of sufficient quality to give photometric curves in which the order of magnitude of the irregularities was less than the variations to be measured. These local irregularities were not entirely due to the individual grains of silver in the emulsion but to a great extent to the lack of uniformity of the emulsion. There were spots on the plate of the order of magnitude of a square millimeter which would differ in density from a neighboring one by fifty percent. Unfortunately the thermocouple junction had a length of sensitive spot of the order of only a millimeter.

Because of the irregularities in a plate, a single photometric curve could not be used to locate the absorption bands with certainty. This

[1] C. B. Crofutt, Phys. Rev. **24**, 9 (1924).

[2] The microphotometer is a modification of that described by Harrison, J.O.S.A. & R.S.I., **10**, 157 (1925). In this article are references to the literature.

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THE K AND L ABSORPTION AND EMISSION SPECTRA OF TUNGSTEN

By C. B. Crofutt

Abstract

Both the absorption and emission spectra were photographed simultaneously on the same plate, using a special float-operated mechanism to turn the crystal very slowly so as to obtain the faint lines between β_3 and β_5. The *absorption wave-lengths* were found to be: LA_1, 1.2122A; LA_2, 1.0716A; LA_3, 1.0217A; KA, .17802A. Table I gives the *emission wave-lengths* of 28 L emission lines including the four new lines β_{15} (1.2432), β_{16} (1.2166), γ_{12} (1.0748) and n (1.0699), and of the Kβ_3 line (.18525) which is the line found by DeBroglie. *Comparison with the Bohr theory.* The agreement of the emission frequencies computed from the energy levels with the measured wave-lengths is better than 1/10 per cent, except for β_{15} and β_{16}. The lines β_{10}, β_9, γ_{12}, and γ_{11}, however, correspond to transitions between energy levels which are not predicted by the selection principle, and lines β_8 and n are not in agreement with the accepted energy levels. While Ln may be due to an impurity, β_8 is probably a tungsten line.

THIS work is an investigation of the absorption and emission spectra of tungsten under the same experimental conditions. Both spectra were obtained simultaneously on the same photographic plate in order to make certain the relative positions of the absorption limits and the emission lines.

Experimental Method

A medium focus tungsten target Coolidge tube was used as a source of x-rays. The x-rays were analyzed by means of a rock salt crystal and the spectra were recorded on photographic plates. The apparatus is essentially that used by Dershem[1] with the substitution of an accurately constructed crystal table, a narrow slit of 0.005 cm width, and a new rotator for the crystal.

The crystal table is shown in Fig. 1 and consists of a spindle fitted in bearings as shown. This spindle is removable and additional spindles make it possible to change crystals without remounting each time.

The crystal was rotated through a small angle by means of levers attached to a float in a tank of water, the level of which was raised by means of a small stream of water and lowered by the use of an intermittent syphon. The advantage of this method is that the crystal can be set for a particular line and a prolonged exposure taken with the as-

[1] Dershem, Phys. Rev. 11, 461 (1918)