Structure of a New System of CO Bands

IN a previous note[1] the discovery of a new system of red-degraded CO bands, placed just before the heads of the violet-degraded Third Positive system, was reported. Inspection and measurement of high-dispersion spectrograms now show that the new bands have a structure appropriate to a $^3\Sigma \rightarrow {}^3\Pi$ band-system, the lower state being the $a^3\Pi$ state, which is the usual final state of the CO triplet systems. The upper $^3\Sigma$ levels of the new bands lie about 83705 cm.$^{-1}$ and 85885 cm.$^{-1}$ above the CO ground state; they have observable spin-splittings and rotational constants $B' = 0{\cdot}7$ to $0{\cdot}8$ cm.$^{-1}$. The system may tentatively be designated as $f^3\Sigma \rightarrow a^3\Pi$. It may be considered, however, as probably due to transitions from the higher vibrational levels of $a'^3\Sigma$ to the lower vibrational levels of $a^3\Pi$. For, within the heights of the initial levels $f^3\Sigma$ of the new bands occur also the initial levels $b^3\Sigma$ of the Third Positive bands, and the latter are strongly perturbed, as has already been established[2], by vibrational levels of the $a'^3\Sigma$ state, for which we have predicted term values and rotational constants of the magnitude now observed for the new bands.

Rotational analysis and details will be published shortly elsewhere.

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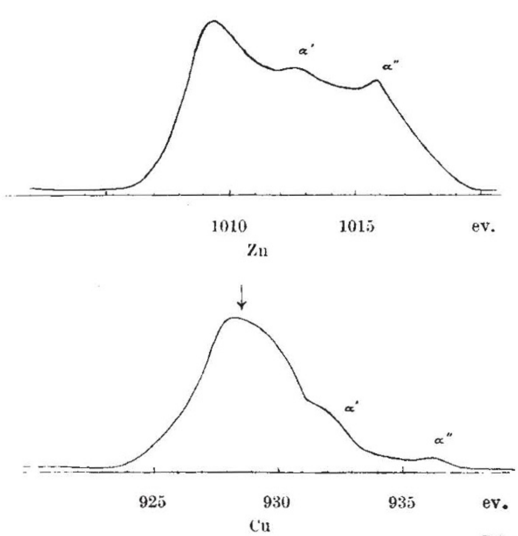
[1] Schmid, R., and Gerö, L., *Naturwiss.*, **25**, 90 (1937).
[2] Schmid, R., and Gerö, L., *Z. Phys.*, **105**, 36 (1937) **106**, 205 (1937).

L-Emission Bands of Zinc, Copper, Nickel and Cobalt

I HAVE studied the intensity of the *L*-emission bands of metals from Co (27) to Zn (30). The apparatus used was a vacuum spectrograph using a bent crystal of mica, and the source of the radiation was an X-ray tube.



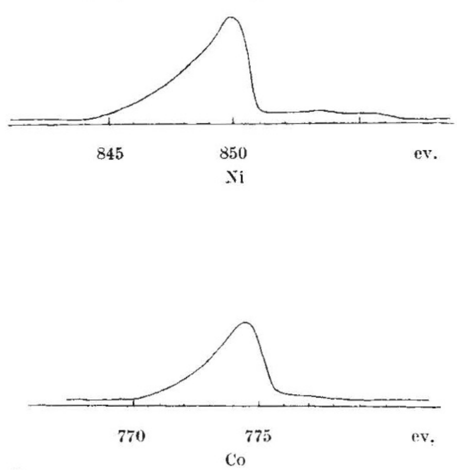


Fig. 1

To obtain the actual intensity distribution of the emitted radiation, the plate was calibrated by a method already described[1]. The curves giving the intensity of the L_α bands against energy (in electron-volts) are shown in Fig. 1.

It is well known that the *L*-emission bands are emitted when $M_{IV,\,V}$-electrons make transitions into the $L_{II,\,III}$-levels ($L_{\alpha_{1,2}}$ and (L_{β_1}). There are also transitions of N_I-electrons into the $L_{II,\,III}$-levels. For these metals the N_I- or 4*s*-electrons are the conduction electrons, and occupy levels which overlap in energy those of the $M_{IV,\,V}$- or 3*d*-electrons.[2] Thus the observed bands represent transitions of both 3*d*- and 4*s*- electrons. But for copper and zinc, unfortunately, the short wave-length ends of the bands, which are probably due to the 4*s*-electrons, are completely masked by satellites, which are strongly enhanced by the reorganization of the atom on account of the Auger effect[3], L_I–L_{III}.

The position of the short wave-length edge of the L_α-bands may be estimated from the *L*-absorption spectra, and is given by the wave-length of the slope of the absorption curve near the minimum absorption. For copper, we can deduce from the absorption curve of Sandström[4] that the edge of the L_α-emission band is given by the arrow marked on Fig. 1. From the comparison of the *L*-emission and absorption bands it is obvious that the width of the L_α-band is about 5 ev.

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Aug. 3.

[1] *Comptes rendus*, **204**, 1242.
[2] See Mott and Jones, "The Theory of the Properties of Metals and Alloys" (Oxford, 1936), p. 191.
[3] See Coster and Kronig, *Physica*, **2**, 13 (1935).
[4] Sandström, A., Thesis, Uppsala (1935).

M-Emission Bands of Zinc, Copper and Nickel

WE have had the opportunity of seeing Dr. Farineau's letter before it was sent to press. We have recently observed the *M*-emission bands of nickel, copper and zinc metals, and it seems worth while to add a note, since the two sets of results, especially taken together, allow one to draw certain conclusions about the structure of the 3*d*- and 4*s*(conduction)-electron bands in these metals.

Our plates, taken with a concave grating spectrograph in the region 130–210 A. and with an X-ray tube run at 3,000 v. as source, give results which, on a scale of energy, are almost identical with Farineau's *L*-emission bands. This is good evidence that, apart from transition probability factors, the curves represent features of the density-functions of the combined 3*d*-conduction-levels of the metals. We also obtain for zinc and copper the peaks marked α′ and α″ by him. But, contrary to his conclusion, when we compare the wave-lengths of points on the *M*-emission bands with the wave-lengths of the *M*-absorption edges which we have determined[1], we