X-Ray Diagram Lines Strongly Absorbed in the Absorption Spectra

By

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Abstract

Continuing his research on the origin of the X-ray absorption edge, the author adopted the method of determining the relative position of the emission line and the corresponding absorption limit from the diminution of the intensity of the line passing through an absorbing screen of the same element. It was found that (1) $L\beta_5$ lines of W and Pt were strongly absorbed, (2) the Au $L\beta_5$ line was absorbed somewhat more than other lines on the longer wave-length side of the edge, and (3) the Cu $K\beta_2$ and the Pt $L\gamma_6$ lines were only slightly absorbed. From these results an explanation of the origin of the absorption limit is propounded.

In the previous research on the relation between the K absorption edge and the $K\beta_2$ line of Ni, Cu and Zn[1] the author found that in the case of Cu the line and the absorption limit fell so near each other that it was impossible to decide which was on the shorter wave-length side. The object in the present investigation was to elucidate this relationship from the intensity of the emission line absorbed by a screen of the same element. For this purpose the author used a copper anticathode, on which a small amount of zinc was electrically deposited, and a copper absorbing foil with a mass of 13 milligrams per square centimeter. The spectrograms were taken on two different horizontal portions of the same plate, one corresponding to the case where the absorber was used, and the other to the case where it was not used. The exposure was carried out for the two portions alternately several times. The time of exposure was so adjusted as to give a slightly stronger intensity for the portion with the absorber on the longer wave-length side of the absorption limit. Thus from the comparison of the two parts on the plate it was easily concluded that

1. S. Kawata: These Memoirs, 14, 55 (1931)

also in the case of Cu the $K\beta_2$ line is located on the longer wave-length side of the K absorption limit[1]. This method is due to Walter[2]. He used the method for the determination of the absorption edges of Ni and Zn, but the author found it very effective especially for such an investigation as the present.

Recently Sandström[3] has reported some interesting results drawn from the measurements made by himself and some other investigators. According to these results the $L\gamma_6$ lines of Ta, Re and Ir are of shorter wave-lengths than the L_{II} limits, and the $L\beta_5$ lines of W, Re, Ir and Pt of shorter wave-lengths than the L_{III} limits, and this will be of great importance for the knowledge of the origin of the absorption limit[4]. But it seemed to the author from his experience in connection with the K limit and the $K\beta_2$ line that some ambiguity must accompany such delicate results when the data are obtained from the comparator readings, especially those of different investigators. He therefore undertook the task of ascertaining the existence of such lines of wave-lengths which coincide with or are shorter than the absorption limit, using the above mentioned method.

The experiment was carried out for W $L\beta_5$, Pt $L\beta_5$, $L\gamma_6$ and Au $L\beta_5$. In the case of Pt and Au a rolled foil of each metal weighing 20 milligrams per square centimeter was used, while in the case of W the metallic powder mixed with Zaponlack and spread upon a filter paper to the mass of 18 milligrams per square centimeter was used.

The results were that (1) W $L\beta_5$ and Pt $L\beta_5$ were distinctly absorbed, (2) Pt $L\gamma_6$[5] was only slightly absorbed and (3) Au $L\beta_5$ was absorbed somewhat more than the other lines on the longer wave-length side of the limit but not so much as the W and Pt $L\beta_5$ lines.

Thus, it may be concluded that (1) the L_{III} limits of W and Pt correspond to the transition from L_{III} to O_V, (2)[5] L_{II} of Pt corresponds to the transition from L_{II} to the level outside the O_{IV} and (3) Au L_{III} electrons may sometimes stop at $O_{IV, V}$.

In conclusion, the author wishes to express his cordial thanks to Prof. Ishino for his kind guidance throughout the research.

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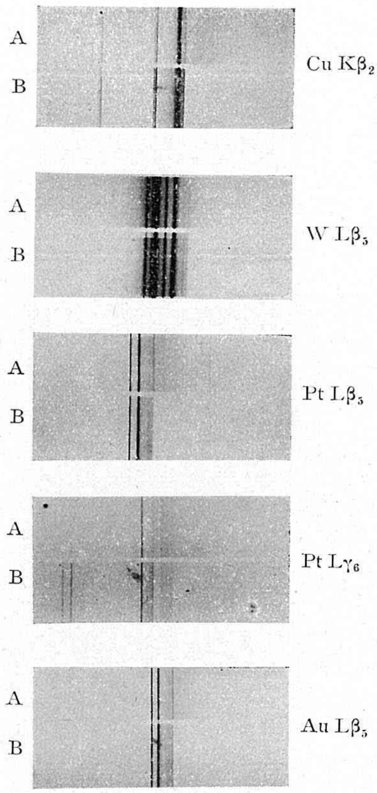
1. It must be noticed, however, that the relation between the $K\beta_2$ line and the K limit is different for the elements Ni, Cu and Zn, as mentioned in the former paper.
2. B. Walter: Zeits. f. Phys., 30, 350 (1924).
3. A. Sandström: Zeits. f. Phys., 66, 784 (1930).
4. Cf. M. Siegbahn: Zeits. f. Phys., 67, 567 (1931).
5. In reality the expression "Pt $L\gamma_6$ line" is not adequate in this case, because that line appears on the photographic plate only as a superposition of the $L\gamma_6$ and $L\gamma_2$ lines, and so conclusion (2) may be somewhat ambiguous, though it seems highly probable that it is correct.



A : Spectrum without the absorber.
B : Spectrum with the absorber.