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INVESTIGATION OF THE MAIN K X-RAY ABSORPTION EDGE IN SELENIUM

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The position and the width of the K x-ray absorption edge of crystalline and amorphous selenium are measured. The dependence of the main absorption edge on the thickness of the absorber is investigated.

THE main K x-ray absorption spectrum of selenium was investigated by a number of authors.[1-3] In stating their experimental methods, the authors did not indicate the structure of the absorbers; apparently they investigated crystalline selenium.

Investigating the L absorption spectrum of selenium, Rudström and Sjöberg[4] found that a transition from the crystalline into the amorphous state leads to a change in the absorption spectrum. In connection with these results, the investigation of the K absorption spectrum of crystalline and amorphous selenium is of interest.

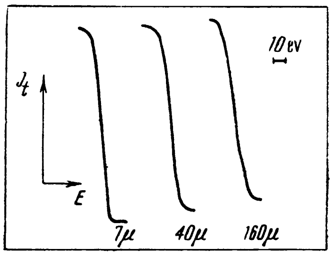
The investigation was carried out with the aid of a bent-crystal Cauchois-type spectrometer with a radius of 41.6 cm. We used the reflecting ($\bar{2}01$) planes of a mica crystal. The absorbers were prepared: a) by vacuum evaporation, and b) by glueing powder onto a mica foil. The thickness of the absorbers varied from 4 to 160 μ.

We found the position of the main absorption edge of crystalline selenium to be K = 12652.6 ev (977.86 xu). This value coincides with the results (12653.4 ev) of other authors.[1,3]

W. H. Zinn determined the width ΔK of the main absorption edge by Ross' method.[5] The value determined by this method depends on the thickness of the absorber. Therefore, we used Sandström's method[6] for determining the width of the main absorption edge. The value obtained by Sandström's method does not depend on the thickness of the absorber, and amounts to 17.2 ev, i.e. 1.33 xu, instead of 7.9 ev as found by Zinn.

We also observed the structure elements of the main absorption edge which had been observed by Hulubei and Cauchois,[3] namely the "white line" at a distance of 5 ev, and the "black line" at a distance of 13 ev from the main edge.

An increase in the absorber thickness leads to the appearance of "structure" in the main absorption edge. This structure was observed on the short-wave side by Parratt, Hempstead, and Jossem,[7] and by Vaĭnshteĭn,[8] who also explained this effect. Our experiments show that on increasing the absorber thickness, structure also appears on the long-wave side (see the figure). On increasing the absorber thickness to 160 μ we observed a 1.8-ev shift of the point of inflection of the K absorption edge of selenium, towards shorter wavelengths. Such a shift was predicted by Sandström,[6] and also experimentally shown in other works.[7,8]



The main K absorption edge in selenium for various absorber thicknesses. J_t is the intensity of the transmitted x-ray beam.

The investigation of amorphous selenium led to the results listed in the table, where δ denotes the distance between the main K absorption edges of crystalline and amorphous selenium. It should be noted that Shiraiwa, Ishimura, and Sawada[9] investigating germanium observed that the transition from the crystalline to the amorphous state caused a 4-ev shift of the point of inflection of the K absorption edge, towards higher energies. This result is analogous with our result.

From the table it can be seen that during a transition from the crystalline to the amorphous state the width of the main edge increases by (4.65 ± 0.5) ev. However, since even an estimate of the error in such measurements is difficult, it seems to us that only the increase itself in the width of the main edge is of interest.

Small amounts of impurities affect both the position of the point of inflection and the width of the main absorption edge of selenium. We ob-

	K		ΔK	
	ev	xu	ev	xu
Crystalline state	12652.6	977.86	17.2	1.33
Amorphous state	12649.8	978.08	21.8	1.69
δ	2.8	—0.22	—4.6	—0.36

served this effect when investigating 99.9% pure selenium.

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