Vol. A58 (1980) ACTA PHYSICA POLONICA No 4

ORIGIN OF $L\beta$ SATELLITES OF CADMIUM

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(Received January 18, 1980)

A comparison has been made between EXAFS of L_2 and L_3 absorption edges and $L\beta$ satellites of cadmium. It has been found that all the observed satellites present good evidence for the validity of Hayasi's theory for the origin of X-ray satellites.

PACS numbers: 32.30.Rj, 32.70.Jz

Besides the theory of multiple ionisation [1] for explaining the origin of satellites in X-ray spectra, one of the quasi-stationary states proposed by Hayasi [2] has also received wide support. Quasi-stationary states of an electron in an atom are formed when an outgoing electron wave interferes with a similar wave which had suffered a Bragg reflection from an atomic lattice within the solid. These quasi-stationary states give rise to secondary absorption maxima associated with an edge in the X-ray absorption spectra. Hayasi [3] had observed that in K-X-ray emission spectra of nickel and copper, the energy difference between a satellite and a nearby parent line is very close to difference between two secondary absorption maxima associated with the corresponding K-absorption edge. A similar correlation between K-absorption and emission spectra of magnesium [4] and aluminium [5, 6] were also reported. Looking at this correlation, Hayasi proposed [2] that an X-ray satellite is emitted when a normal X-ray transition is accompanied by a transition of an electron between two quasi-stationary states. Such two electron one photon transitions are allowed according to the Heisenberg selection rules [7]. Based on this theory, Rai and Rai [8] had explained the presence of K-satellites of yttrium and Nigam and Soni [9], recently, have explained the origin of K-satellites of zirconium. Amongst the satellites in L-spectra, similar studies have so far been reported only on $L\alpha$ satellites of silver [10, 11] and cadmium [12, 13]. It was therefore thought worthwhile to extend this study to other regions of L-spectra. In this paper, the results of the study on $L\beta$ satellites of cadmium are presented.

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TABLE I

Correlation between $L\beta_1$ satellites and EXAFS of L_2 absorption edge of cadmium

S.No.	Satellite[a]		Shift relative to the energy of $L\beta_1$ line (3316.6 eV)	Differences between secondary absorption maxima (eV)
	Name	Measured energy (eV)		
1	β_1'	3325.5	8.9	$B-A$ 8.4
2	β_1''	3332.6	16.0	$C-B$ 15.3 $D-C$ 16.3 $E-D$ 16.0
3	β_1'''	3340.3	23.7	$C-A$ 23.7
4	β_1''''	3347.1	30.5	$D-B$ 31.6 $E-C$ 33

[a] Data taken from Ref. [15] and converted from x.u. to eV units by the conversion factor 12372.2×10^3 x.u. eV.

TABLE II

Correlation between $L\beta_2$ satellites and EXAFS of L_3 absorption edge of cadmium

S.No.	Satellite[a]		Shift relative to the energy of $L\beta_2$ line (3528.1 eV)	Differences between secondary absorption maxima (eV)
	Name	Measured energy (eV)		
1	$\beta_2^{(a)}$	3533.9	5.8	$B-A$ 7.5
2	β_2^{I}	3558.0	29.9	$D-B$ 31.9
3	$\beta_2^{(b)}$	3562.8	34.7	$E-C$ 33
4	β_2^{II}	3567.3	39.2	$D-A$ 39.4
5	$\beta_2^{(c)}$	3573.5	45.4	$F-E$ 46

[a] Data taken from Ref. [15] and converted from x.u. to eV units by the conversion factor 12372.2×10^3 x.u. eV.

Sandström [14] has reported the presence of five secondary maxima at separations of 13.5, 21.9, 37.2, 53.5 and 70 eV from the main L_2 absorption edge of cadmium. Naming these as A, B, C, D and E respectively, differences of all possible pairs of these secondary maxima have been calculated. Using the data on $L\beta$ satellites of cadmium [15], it is observed that the energy separations of all the four satellites from the β_1 line (3316.6 eV) can be found amongst many of the energy differences of secondary absorption maxima pairs. This correlation is shown in Table I. Similar correlation between six secondary absorption maxima from A to F, observed [14] at separations of 13.9, 21.4, 37.6, 53.3, 71 and 117 eV respectively from the L_3 edge, and satellite parent differences in $L\beta_2$ spectrum of cadmium [15] are shown in Table II. Good agreement between the last two columns of each of these tables confirms the validity of Hayasi's theory for the origin of satellites.

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