J. Edu. Sci., Vol. (17) No. (3) 2005

Relative Intensity (Kα1 / Kβ1) of the Transmitted K x-ray for Light Atom

S. H. AL- Shamma **K. I. Saeed**
Physics Department - College of Education
Mosul University, Mosul-Iraq

Received **Accepted**
27/6/2005 **18/9/2005**

الخلاصة

تم في هذا البحث قياس الشدة النسبية ($k\alpha_1$ / $k\beta_1$) للذروات المميزة من عنصر النحاس في انبوبة الاشعة السينية والنافذة من خلال مرشحات العناصر الخفيفة الستة (فناديوم ، كروميوم ، منغنيز ، الحديد ، النحاس والخاصين).

تم تهيج هذه العناصر بالخطين المميزين (Cu—$k\alpha_1$, Cu-$k\beta_1$) والتي تقابل طاقات الاشعة السينية(8.05 و 8.92) كيلو الكترون فولت على التوالي ولقد اظهرت النتائج المقاسة اتفاق جيد مع نتائج نظرية وعملية منشورة.

ABSTRACT

In this paper, we report the measurements of the relative x-ray intensity($k,\alpha_1/k\beta_1$) for six elements (V,Cr, Mn , Fe , Cu , and Zn) .These element were excited by two lines (Cu—$k\alpha_1$ and Cu-$k\beta_1$) with corresponding energies of 8.05 keV and 8.92 keV respectively . These results show a good agreement with previous experimental and calculated published data.

INTRODUCTION

A vacancy in an inner levels of an atom may be filled by an electron from a higher levels accompanied by the ejection of either an Auger electron or an x-ray photons (1,2,7,8) with the resolving power available . In modern x-ray spectroscopy many of lines have been resolved into two more components (1) . A knowledge of relative intensity ratio is required in the interpretation of x-ray following charged particle bombardment . Furthermore , relativistic calculations of radiative transition rates were carried out by many groups (5,6,9.10) . Measured

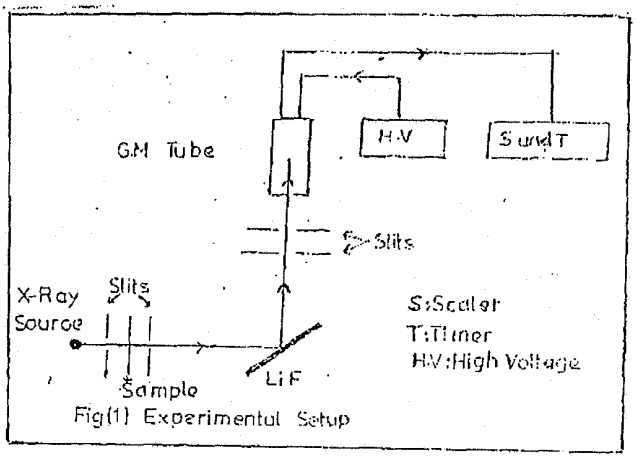
values of the relative intensity of the transmitted k-x-ray have been carried out for a high (Z) of elements are reported (2,3,4) .

The purpose of this work is to provide an experimental measurements of the relative intensity ratio ($k\alpha_1/k_{\beta 1}$) for six light elements (V , Cr , Mn , Fe , Cu and Zn).

These elements were excited by two distinguished lines Cu—$k\alpha_1$ and Cu-$k_{\beta 1}$ corresponding energies (8.05 keV and 8.92 keV).

EXPERIMENTAL

Relative intensity of k x-ray $\mathbf{k\alpha_1/k\beta_1}$ has been carried out by using a Bragg diffraction spectrometer . The geometry used with this device is shown in fig (1) . It consists from high vacuum hot cathode x-ray tube equipped with a copper anode . The maximum current passed through the tube was (0.08 mA) and the voltage a cross the tube was (30 kv) . This apparatus is designed as a horizontal counter tube goniometer with rotable carriage arm and sample post in the axis of rotation . The target elements used in this work were in the form of metal foils such as (V , Cr , Mn , Fe , , Cu and Zn) . These foils are of thickness (12, 14 , 14 , 14 , 12,11) $x10^{-4}$ cm respectively . The direct beam from the x-rays tube as shown in fig (1) is directed to the LiF crystal , after being diffracted by the crystal passed through slit system and then detected by the G.M tube . Finally , the G.M. tube is connected to a standard counting electronics . The Full width at half maximum (FWHM) of the peaks ($k\alpha_1$and $k_{\beta 1}$) observed with this spectrometer was 1 and 1.3 in 2Θ respectively . Air absorption was negligible at x-ray energies used for G.M. tube used in this work. The angular increment was 1° between the data points . Sufficiently counting time was used so that the errors due to the counting statistics were negligible in the measured intensities $k\alpha_1$and $k_{\beta 1}$ peaks . All the data were analyzed by the peak height rather than the peak area . The background radiation under the peak was assumed to be a linear interpolation of the count rates and then subtracted away from all the measurements . Furthermore , a suitable checks have been made before taking the measurements that the number of beta particles emitted from the sample were small and can be neglected.This can be achieved by taking Al foils with width equal to the range of beta particles . Thus only x-ray is emitted from the sample .



Fig(1) Experimental Setup

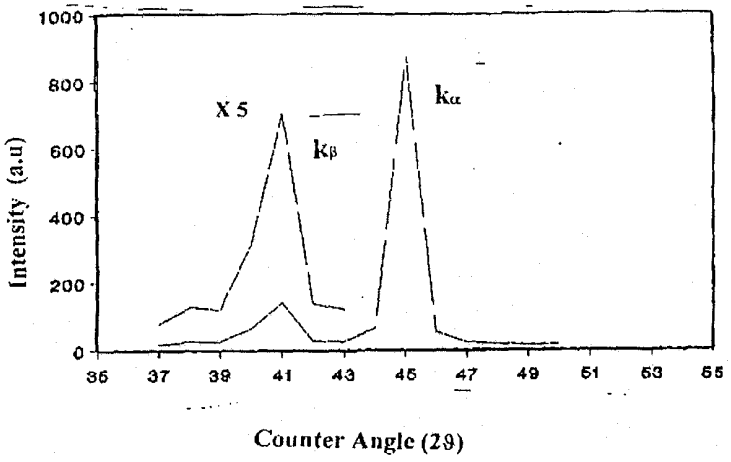


Fig. (2) Copper X-Ray Spectrum

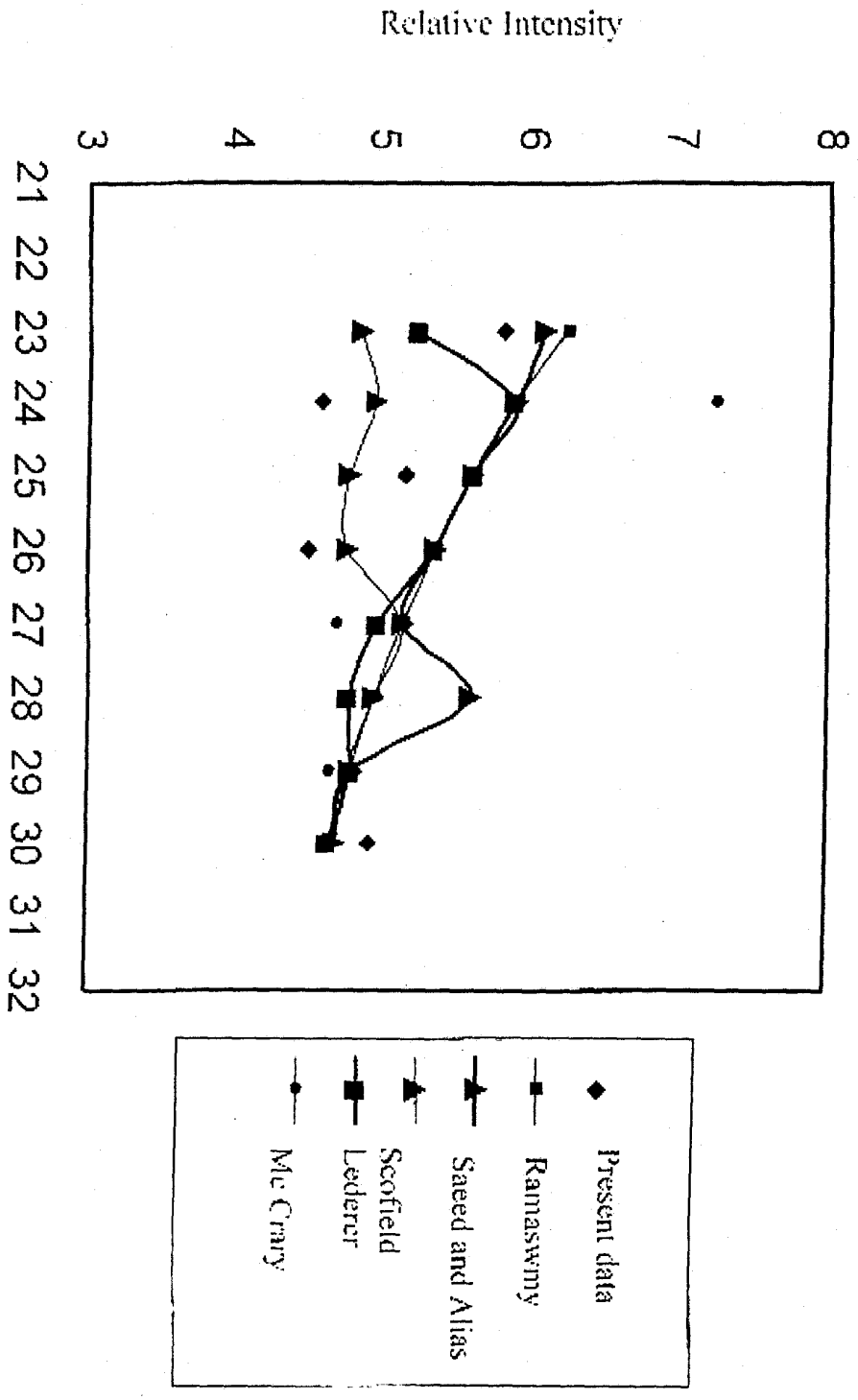
RESULTS AND DISCUSSIONS:

A plot of Cu- k x-ray spectrum is shown in fig (2) . The two peaks $k\alpha_1$and $k_{\beta 1}$ are well analyzed . The intensity ratio was analyzed by measuring the peak height and was found to be equal (7.15) . Table (1) shows the relative intensity ($k\alpha_1$/ $k_{\beta 1}$) for Cu – k – spectrum from different absorbing foils such as (V , Cr , Mn , Fe , Cu and Zn) with corresponding atomic numbers (23, 24 , 25 , 26 , 29 and 30) respectively . Also this table includes other data for $k\alpha_1$ / $k_{\beta 1}$ that are computed by relativistic calculation and experimentally measured by other workers for comparison . Furthermore , these data are drawn as shown in fig (3) . In our measurements the relative intensity of the background under $k\alpha_1$and $k_{\beta 1}$ peaks were found to be less than 7% .

In addition , the relative intensities ($k\alpha_1$/ $k_{\beta 1}$) were analyzed by taken a peak height rather than the peak area . the present data show a good agreement with the equation formulated by Ramaswamy except Cr and Fe in which the calculation shows a slightly higher value . The same thing happen between present data and with relativistic computation by Saeed and Alias . As we see from the table that present data show a good agreement with the relativistic calculation by scofield . The experimental data by Lederer show a good agreement with present data except for Cr and Fe which look slightly higher . The experimental measurements by Mc Crary for Cr seems to be higher than those for other workers . the discrepancy between the present measurement of Co and Ni with the calculated values is due to the absorption for Co and Ni which lie near the $K_{\beta 1}$ peak of Cu . So for this reason , we are not recording the relative intensity values for . Cu and Ni in the table .

Table (1) : The measured and computed k x-ray relative intensity

Elementz	Z	Present data	Computed Ramaswmy (6)	Computed Saeed and Alias (10)	Computed scofield (9)	Experimental Lederer et .al (3)	Experimental Mc Crary (4)
V	23	5.81	6.2364	6.097	4.8473	5.2267	
Cr	24	4.59	5.8941	5.898	4.9554	5.8858	7.225
Mn	25	5.16	5.6042	5.605	4.7801	5.6053	
Fe	26	4.57	5.3579	5.359	4.7573	5.3533	
Co	27		5.1445	5.144	5.14	4.9677	4.686
Ni	28		4.9576	5.608	4.95	4.7805	
Cu	29	4.82	4.7592	4.7915	4.7915	4.7868	4.6520
Zn	30	4.92	4.6458	4.6838	4.6838	4.6468	



Fig(3) Relative Intensity versus Atomic Number

CONCLUSION

We present an experimental results for measuring the transmitted relative intensity ratio ($k\alpha_1$/ $k_{\beta 1}$) for six elements (V , Cr , Mn , Fe , Cu and Zn) .

These result show a good agreement in comparison with the relativistic calculation and experimental results that were published in previous studies .

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