

MTS723 F97 Homework 3 Solution J. J. Weimer 3.Nov.97

▣ Problem 1

part a

The following values were determined from the graph.

Before baseline subtraction

The peak position measured by software is 426.7 eV

The peak half width measured by a ruler on the hard copy of the graph is 1.43 ± 0.07 eV (the error is determined based on measurement error)

After baseline subtraction

The peak position has not changed by a measurable amount.

The peak half width, measured by a ruler on the hard copy of the graph, is 1.45 ± 0.06 eV. This is within the error range of the value determined with a baseline.

part b

The total area under the two peaks was determined by integrating via software. It was found to be 3212 C•eV/s. This value will vary depend on the method you used.

The relative areas for the two peaks were found to be 72% and 28 %. Relative measurement errors are estimated to be $\pm 3 - 5\%$.

▣ Problem 2

See the graph for the results.

▣ Problem 3

part a

Measurements were done using a ruler with scale markings every millimeter.

The ratios were determined for the three separate curves (labelled A, B, and C from bottom to top).

$$RA = 1.42 \qquad RB = 2.30 \qquad RC = 2.32$$

The average value was determined to be 2.0 ± 0.5 . This value does NOT account for measurement errors.

From the composite spectrum, the ratio was determined to be 2.02 ± 0.08 . This only accounts for measurement errors.

Comments

The composite spectrum provides the same ratio value as if we averaged the three values, however we do not have the benefit of a direct measure of random error without returning to the original spectra and calculating it.

part b

Signal to Noise was determined by measuring the height of the peak at 401 eV and the width of the scatter in the data values over a range near 405 eV. The following values were obtained for the three spectra:

$$(S/N)_A = 12.75 \quad (S/N)_B = 11.2 \quad (S/N)_C = 16.25$$

The resulting S/N value for the composite spectrum should therefore be about 23 - 24 according to

$$> \text{StNcomposite} := \text{sqrt}(12.75^2 + 11.2^2 + 16.25^2);$$

$$\text{StNcomposite} := 23.49606350$$

For the composite spectrum, the S/N value was found to be about 25. The theoretically expected value based on co-adding the three spectra is 23 - 24. Given the uncertainty due to measurement errors, the agreement between the calculated value and the expected value is very good.