MEASUREMENT OF THIN COATED LAYERS MEASURING THE K_α / K_β RATIO IN EMISSION OF CHARACTERISTIC X-RAYS

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The existence of high resolution X-ray detectors makes possible the resolution of K_α and K_β lines down to ^{40}Ca. The steep dependence of the photoelectric attenuation coefficient for low X-ray energies results in measurable differences in the K_α / K_β ratios when the characteristic X-rays pass through thin layers of material.

If one has a ratio R_o for the K_α and K_β X-rays emerging from a substrate material the ratio R_m observed after passing the coating layer (provided the coated layer has a different Z) shall be

$$R_m = R_o \, e^{-(\mu_\alpha^c - \mu_\beta^c) x^c}$$

where $\mu_\beta^c, \mu_\alpha^c$ are the linear attenuation coefficients of the coating for the K_α and K_β lines of the substrate respectively. The thickness x^c of the coating is then given by

$$x_c = \frac{1}{\mu_\alpha^c - \mu_\beta^c} \ln \left(\frac{R_o}{R_m} \right)$$

The limiting conditions are the precision of the determination of $(\frac{R_o}{R_m})$, which is ~ 1% and that the lines of the coating should not overlap with the lines of the substrate material.

We have tested the method with success on layers of silver on copper with Ag thicknesses ranging from 3-20 mg/cm^2. The characteristic X-rays from copper were excited using an X-ray tube with a Mo anode.