Thickness Measurement of Common-element Multilayer

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Industries increasingly come out more complex multilayer coatings on mechanic parts and electronics components. One of noticeable trends is often termed as common-element-multilayer structure. In a common-element-multilayer structure, the same element(s) appears at different layers of a multilayer coating structure. Often, elemental compositions of those layers are identical but with different thickness. An example of common-element-multilayer structure is Ni/Cu/Ni/Nb, which has Ni as the first and the third layer, but in between a Cu-layer added to separate two Ni coatings. Another example is the multilayer film of Cr/Cu/Cr. The film consists with 8-micron thickness of Cu layer and two thin Cr layers (approximately about 0.5 nm) on top and bottom of the Cu layer.

XRF coating thickness measurement can have difficulties in measuring layer thickness of common-element-multilayer structure since there are more unknowns than equations with fundamental parameter algorithm. In conventional practice, if there are n common-element layers in a coating structure, thickness of n-1 layers must be known and be input into fundamental parameter algorithm as a constant so that thickness of remaining layers can be determined. However, in real life, often, there is no prior knowledge of layer thickness, and thickness of all common-element layers need to be blindly measured.

With this presentation, two methods of determining thickness of common-element-layers are described. Both methods do not require knowing thickness of any layers. The first method determines Ni/Cu/Ni/Nb layer thickness. The method utilizes Cu K-alpha to K-beta ratio to tell difference between first and third Ni layer. The second method measures thickness of all three layers Cr/Cu/Cr film. The method takes two measurements of opposite sides of the film. Then, with fundamental parameter algorithm a correction was applied to compensate effect of Cr of other side.