# *Course 12.141: Electron Microprobe Analysis* – Hints and solution for Problem Set 4

(1) Note that in the equations, if "i" is the element being considered, "j" stands for all the other elements in the sample. Our samples have only two elements, Fe and Ni. So, when calculating parameters for Fe, "i" is Fe and "j" is Ni. For example, $S_i$ for Fe will be,

$$S_{Fe} = C_{Ni} * S_{Fe\text{-}Ni}$$

where,

$$S_{Fe\text{-}Ni} = (\text{const})\ [(2Z_{Ni}/A_{Ni})/(E_0+E_{c(Fe\ K\text{-}shell)})]\ln[583(E_0+E_{c(Fe\ K\text{-}shell)})/J_{Ni}]$$

See p. 14, Eq 3.12 of Course Notes.

(2) When calculating a parameter for the specimen, you need to find a concentration-weighted average. For example,

$$\left(\mu/\rho\right)^{FeK\alpha}_{specimen} = C_{Fe} * \left(\mu/\rho\right)^{FeK\alpha}_{Fe} + C_{Ni} * \left(\mu/\rho\right)^{FeK\alpha}_{Ni}$$

Note when the concentrations of Fe and Ni are equal, $\left(\mu/\rho\right)^{FeK\alpha}_{specimen}$ becomes a simple average,

$$\left(\mu/\rho\right)^{FeK\alpha}_{specimen} = [\left(\mu/\rho\right)^{FeK\alpha}_{Fe} + \left(\mu/\rho\right)^{FeK\alpha}_{Ni}]\ /\ 2$$

Also note that the standards are pure metals. So,

$$\left(\mu/\rho\right)^{FeK\alpha}_{Fe-standard} = \left(\mu/\rho\right)^{FeK\alpha}_{Fe} = 71.4\ \text{cm}^2/\text{g}$$

$$\left(\mu/\rho\right)^{FeK\alpha}_{Ni-standard} = \left(\mu/\rho\right)^{FeK\alpha}_{Ni} = 90\ \text{cm}^2/\text{g}$$

(3) Note that fluorescence occurs only when the energy of the X-ray being absorbed is higher than the critical excitation energy of the atomic shell of the element it is fluorescing. Since,

$$E_{\text{FeK}\alpha}\ (6.404\ \text{keV}) < E_{\text{c (Ni K-shell)}}\ (8.332\ \text{keV}),$$

FeKα cannot fluoresce Ni. So the fluorescence correction factor of Ni is equal 1.

(4) Your graphs should show the following:

(A) Atomic number correction deviates more and more from 1 as the composition of the sample deviates more and more from the pure element standards.
(B) There is a high positive absorption correction for NiKα at high Fe contents because NiKα is absorbed in Fe.


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(C) There is a high negative fluorescence correction for FeK$\alpha$ at high Ni contents because NiK$\alpha$ fluoresces FeK$\alpha$.

Following are the graphs you should obtain: