APPENDIX

ERROR ANALYSIS

In a general relationship, the error of a quantity such as Z can be derived as the following. Let z, a, b and c be numerical values of the physical quantities Z, A, B and C and k being a constant.

$$Z = k \times A^n \times B^m \times C^p$$
$$z = k \times a^n \times b^m \times c^p$$

Taking logarithms to base e;

$$\mathrm{Ln}\,(z) = \mathrm{Ln}\,(k) + \mathrm{Ln}\,(a^n) + \mathrm{Ln}\,(b^m) + \mathrm{Ln}\,(c^p)$$
$$\mathrm{Ln}\,z = \mathrm{Ln}\,k + n\,\mathrm{Ln}\,a + m\,\mathrm{Ln}\,b + p\,\mathrm{Ln}\,c$$

Differenciating,

$$(1/z)\,\delta z = n(1/a)\,\delta a + m(1/b)\,\delta b + p(1/c)\,\delta c$$

Thus,

% error in Z = n(% error in A) + m(% error in B) + p(% error in C)

A1 : Refractive index (n)

The refractive index of thin films on transparent substrate was given in equation 3.2.

$$n(\lambda) = [\, N + (N^2 - n_o^2\, n_1^2\,)^{1/2}\,]^{1/2}$$

with $N = (n_o^2 + n_1^2\,)/\,2 + 2\, n_o n_1[(\,T_M - T_m)\,/\,T_M T_m\,]$

n is a function of T_M and T_m. Thus the maximum possible error in T_M and T_m is

$$[\ \Delta T_{max}/\ T_{max}\ ] = [\Delta T_{min}/\ T_{min}\ ] = 0.01$$

$$[\ \Delta N(\lambda)/\ N(\lambda)\ ]^2 = [\ (\Delta T_{max} + T_{min})\ /\ T_{max}\ ]^2 + [\ \Delta T_{max}/\ T_{max}\ ]^2 + [\ \Delta T_{min}/\ T_{min}\ ]^2$$

$$= 1 \times 10^{-4}$$

$$[\ \Delta n(\lambda)/\ n(\lambda)\ ]^2 = [\ \Delta N(\lambda)/\ N(\lambda)\ ]^2$$

$$= 1 \times 10^{-4}$$

$$[\ \Delta n(\lambda)/\ n(\lambda)\ ] = 0.01$$

A2 : Film thickness (d)

$$d = (m\lambda\ /\ 2n)$$

Therefore $(\Delta d/d) = (\Delta n/n)^2$

$$= 0.01$$

A3 : Optical energy gap (E_g)

The optical energy gap was deduced from the intercept at the energy axis of the Tauc's plot. Therefore $E_g = C/m$ where C is the intercept on the y-axis and m is the gradient of it's linear portion.

$$[\ \Delta E_g/E_g\ ]^2 = [\ \Delta C/C\ ]^2 + [\ \Delta m/m\ ]^2$$

From the least square method, $[\ \Delta C/C\ ] = 0.002$

$[\ \Delta m/m\ ] = 0.01$

Therefore, $[\ \Delta E_g/E_g\ ] = 0.01$

A4 : Integrated intensity (I)

$$I = S/\omega_o$$

$$[\ \Delta I/I\ ]^2 = [\ \Delta S/S\ ]^2$$

Thus, $[\ \Delta I/I\ ] = [\ \Delta S/S\ ]$

$$= 0.05$$

A5 : Hydrogen content (H%)

From equation 3.13,

$$H\% = N(H)/\ N_{Si}$$

$$= N(H)/\ (\ 5 \times 10^{22}\ )$$

Therefore, $[\ \Delta H\%\ /\ H\%\ ] = [\ \Delta N/N\ ]$

$$= 0.05$$

A6 : Microstructure parameter (R)

From equation 3.12,

$$R = [\ I_{2100}\ /\ (\ I_{2100} + I_{2000}\ )\ ]$$

$$[\ \Delta R/R\ ]^2 = [\ \Delta I_{2100}/\ I_{2100}\ ]^2 + [\ 2\ (\Delta I_{2100} + \ \Delta I_{2000}\ )/(\ I_{2100} + I_{2000}\ )\ ]^2$$

$$[\ \Delta R/R\ ]^2 \cong [\ \Delta I_{2100}/\ I_{2100}\ ]^2$$

Thus $[\ \Delta R/R\ ] = 0.05$

A7 : Urbach tail bandwidth (E_e)

The Urbach tail bandwidh is deduced from the slope of the linear part of plot Ln α versus E near the absorption edge. Thus $E_e = 1/m$ where m is the slope.

Therefore, $(\Delta E_e/E_e) = (\Delta m/m)$

From least square root method,

$(\Delta m/m) = 0.01$

Thus, $(\Delta E_e/E_e) = 0.01$