SEA regression report summary

Sample ID
001c-int-i 70° 1
001c-int-i 65° 2
001c-int-i 60° 3

Details	
Software and regression log	
Software about	Semilab - Spectroscopic Ellipsometry Analyzer - SEA
Software version	1.7.1
Officially licensed to	MIT
Operator	operator
Date and time of regression	01-04-2022 14:28
Comments	

Layer structure	
Overview	

Optical model	
Phase 2	ITO_3
Dispersion law	Lorentz
	Drude
	Lorentz
Phase 1	ITO_3
Dispersion law	Lorentz
	Drude
	Lorentz

Regression results

Measurement information	
Measurement 1	
Measurement file path	C:\Users\emmabat\ito-si\001c-int-i.smdx
Angle of Incidence	70°
Measurement 2	
Measurement file path	C:\Users\emmabat\ito-si\001c-int-i.smdx
Angle of Incidence	65°
Measurement 3	
Measurement file path	C:\Users\emmabat\ito-si\001c-int-i.smdx
Angle of Incidence	60°
Regression details	
Regression 1 (EllipsoReflectance)	
Wavelength range	300.14 - 1599.16 nm
Angle of Incidence	70°
Fit to	<n>, <k>
Regression 2 (EllipsoReflectance)	
Wavelength range	300.14 - 1599.16 nm
Angle of Incidence	65°
Fit to	<n>, <k>
Regression 3 (EllipsoReflectance)	
Wavelength range	300.14 - 1599.16 nm
Angle of Incidence	60°
Fit to	<n>, <k>
Angular Aperture	0°
Fit algorithm	LMA

Results				
Parameters	Value	Fitted	2 σ confidence limit	Unit
Model				
AOI Shift	0			°
Angular Aperture	0			°
Phase 2 (ITO_3)				
Thickness	79.341	X	0.18329	nm
f	0.43598	X	0.013434	
E0 (eV)	3.21739	X	0.010406	eV
Γ (eV)	1.19336	X	0.017877	eV
E_p (eV)	0.63089	X	0.0064165	eV
E_Γ (eV)	0.31235	X	0.010946	eV
f	0.2476	X	0.020074	
E0 (eV)	4.19455	X	0.019047	eV
Γ (eV)	0.92716	X	0.077504	eV
Eps_inf	1.58049	X	0.01418	
Phase 1 (ITO_3)				
Thickness	112.718	X	0.17085	nm
f	0.16357			
E0 (eV)	3.74618			eV

Γ (eV)	0.62015			eV	
E_p (eV)	1.09856			eV	
E_Γ (eV)	0.22823			eV	
f	0.43808				
E0 (eV)	4.29829			eV	
Γ (eV)	0.24163			eV	
Eps_inf	3.4998				
Derived parameters	Value				
Phase 2 (ITO_3)					
n @ 632.8 nm	1.5532				
k @ 632.8 nm	0.0894				
Phase 1 (ITO_3)					
n @ 632.8 nm	1.9911				
k @ 632.8 nm	0.0202				
Substrate (si)					
n @ 632.8 nm	3.8811				
k @ 632.8 nm	0.0195				
Drude derived parameters	Value			Unit	
Phase 2 (ITO_3)					
Conductivity (S/m)	1.7141E+04 ± 949.36			S/m	
Resistivity (mΩ.cm)	5.8338 ± 0.3231			mΩ.cm	
Resistance (Ω/sq)	735.2856 ± 42.4216			Ω/sq	
N type dopant concentration (at/cm3)	7.2167E+19 ± 1.4679E+18			at/cm3	
P type dopant concentration (at/cm3)	1.0681E+20 ± 2.1725E+18			at/cm3	
N type dopant mobility (cm2/Vs)	14.8252 ± 0.8747			cm2/Vs	
P type dopant mobility (cm2/Vs)	10.0171 ± 0.591			cm2/Vs	
Phase 1 (ITO_3)					
Conductivity (S/m)	7.1131E+04 ± 0			S/m	
Resistivity (mΩ.cm)	1.4058 ± 0			mΩ.cm	
Resistance (Ω/sq)	124.7228 ± 0.1891			Ω/sq	
N type dopant concentration (at/cm3)	2.1881E+20 ± 0			at/cm3	
P type dopant concentration (at/cm3)	3.2384E+20 ± 0			at/cm3	
N type dopant mobility (cm2/Vs)	20.2898 ± 0			cm2/Vs	
P type dopant mobility (cm2/Vs)	13.7093 ± 0			cm2/Vs	
Fit quality					
R^2	0.9974				
RMSE	0.03582				

Regression graphs

Legend (top graph):
- ○ 001c-int-i 70° 1 Measured 70°
- □ 001c-int-i 65° 2 Measured 65°
- ◇ 001c-int-i 60° 3 Measured 60°
- ── 001c-int-i 70° 1 Fit 70°
- ── 001c-int-i 65° 2 Fit 65°
- ── 001c-int-i 60° 3 Fit 60°

Legend (bottom graph):
- ○ 001c-int-i 70° 1 Measured 70°
- □ 001c-int-i 65° 2 Measured 65°
- ◇ 001c-int-i 60° 3 Measured 60°
- ── 001c-int-i 70° 1 Fit 70°
- ── 001c-int-i 65° 2 Fit 65°
- ── 001c-int-i 60° 3 Fit 60°

Phase 2 (ITO_3) - Dispersion graphs

Refractive index vs. Wavelength (nm)

Extinction coefficient vs. Wavelength (nm)
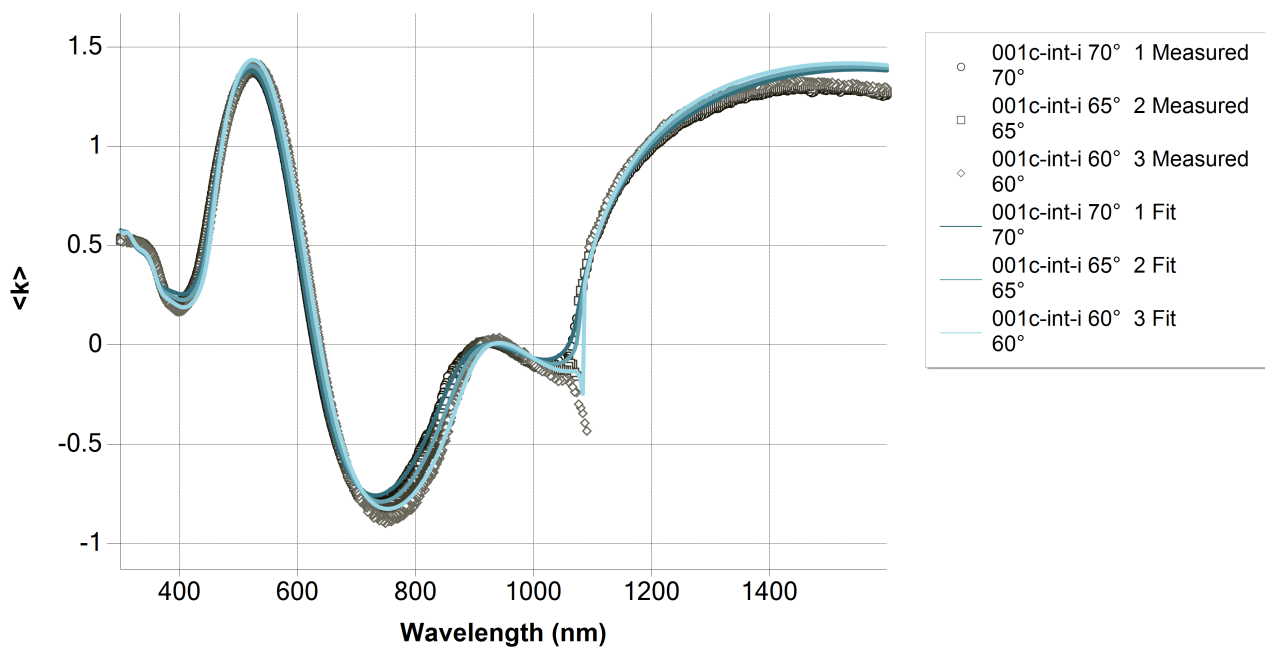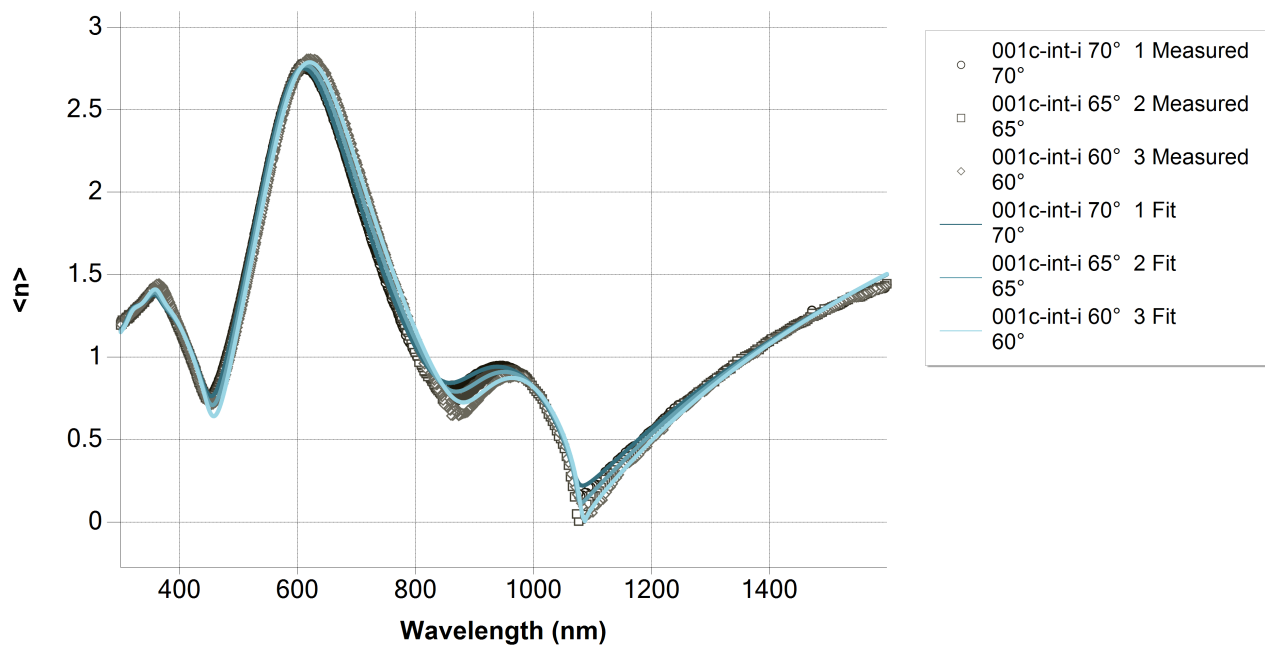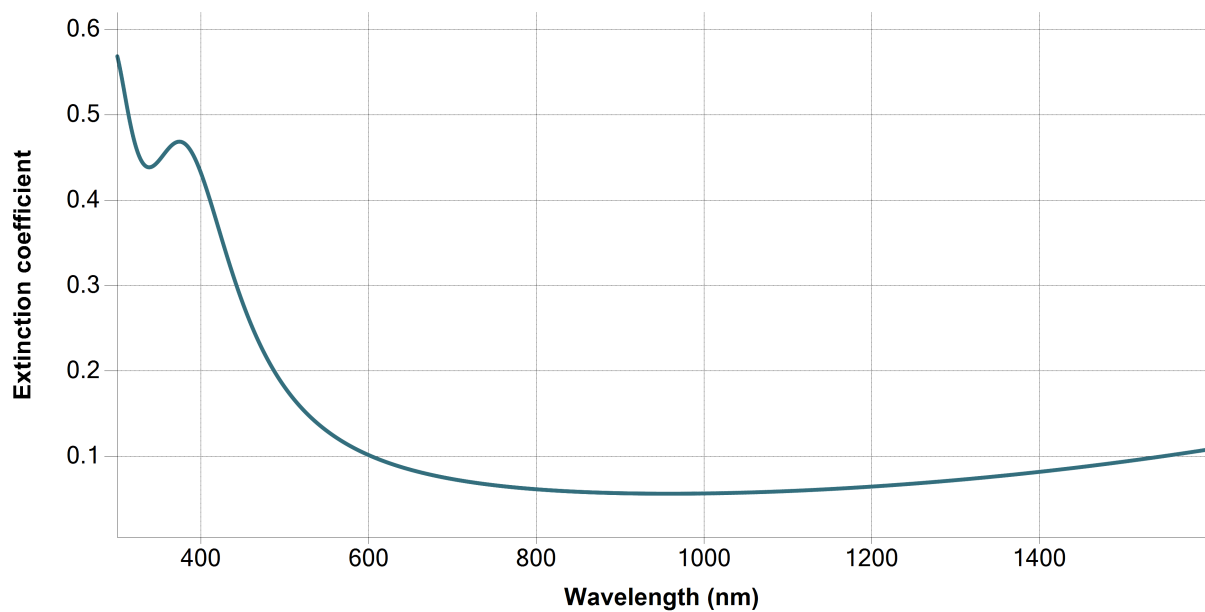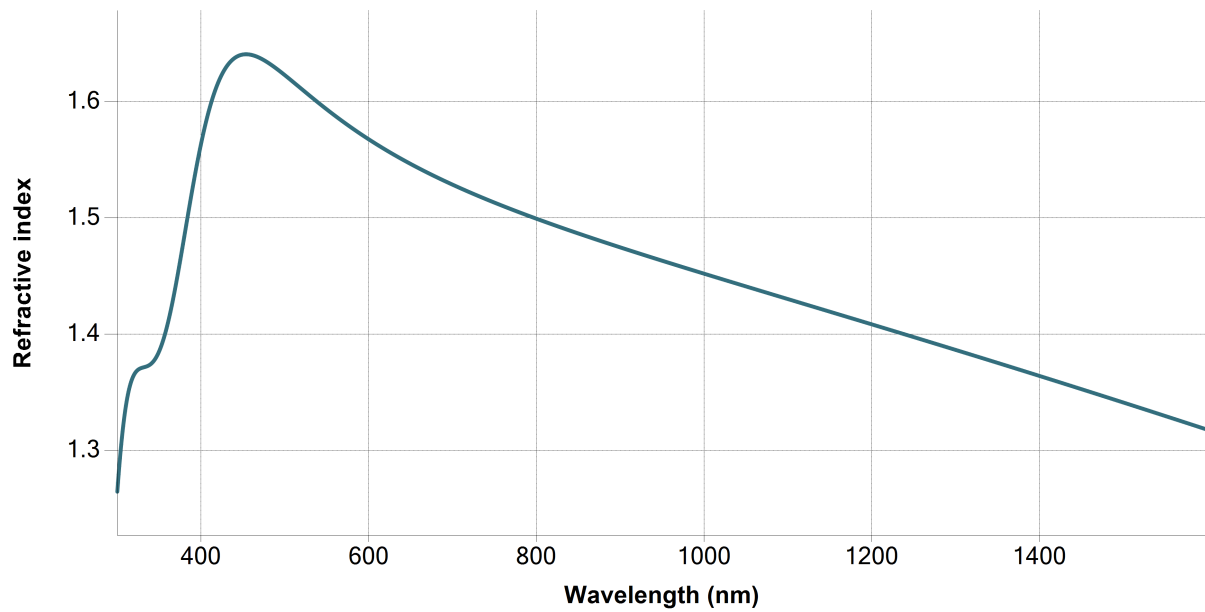
Phase 1 (ITO_3) - Dispersion graphs
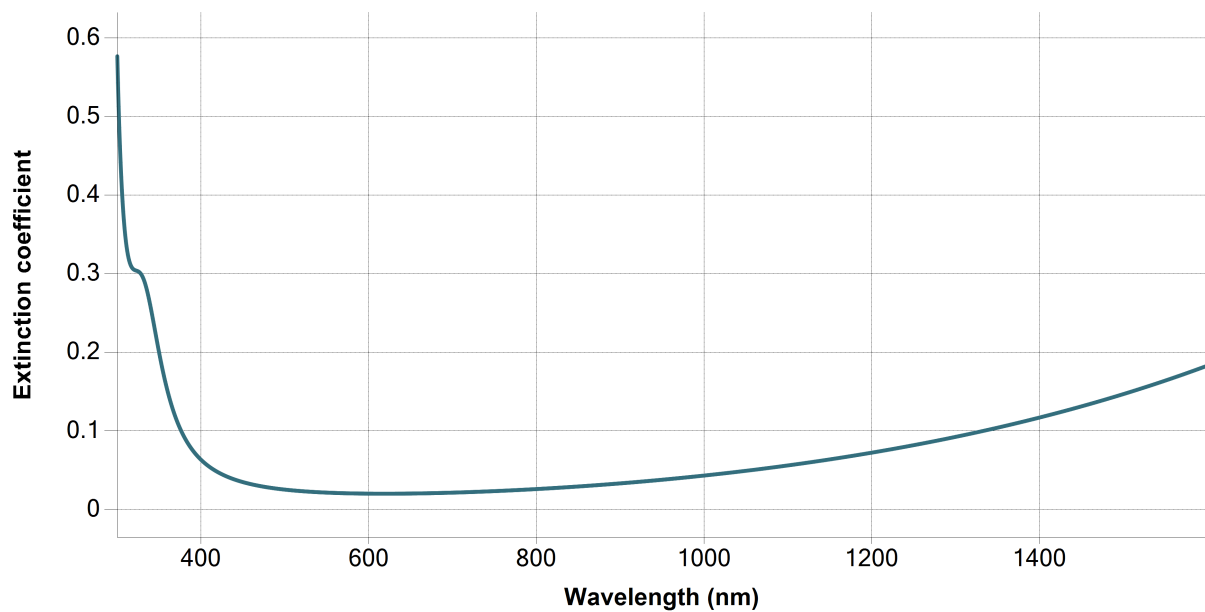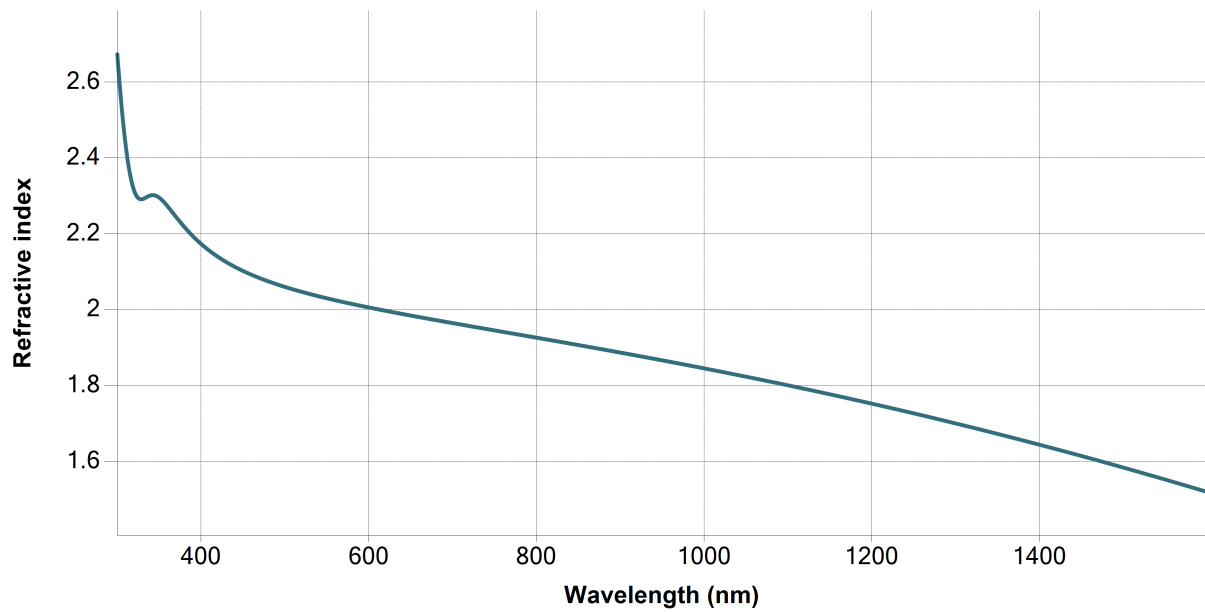
Substrate (si) - Dispersion graphs
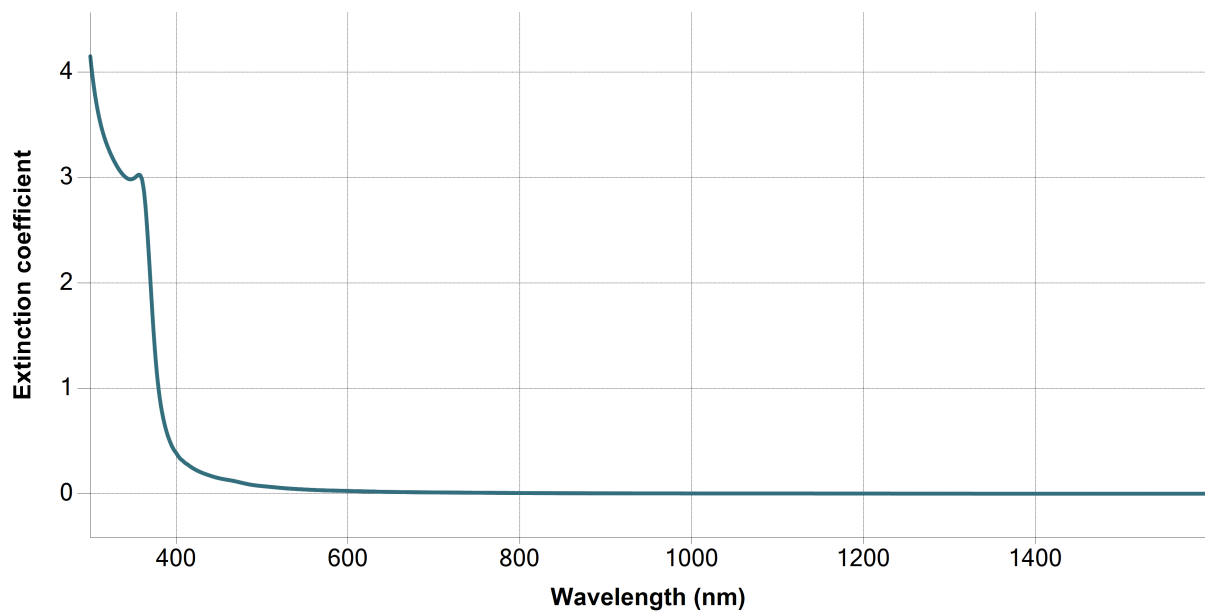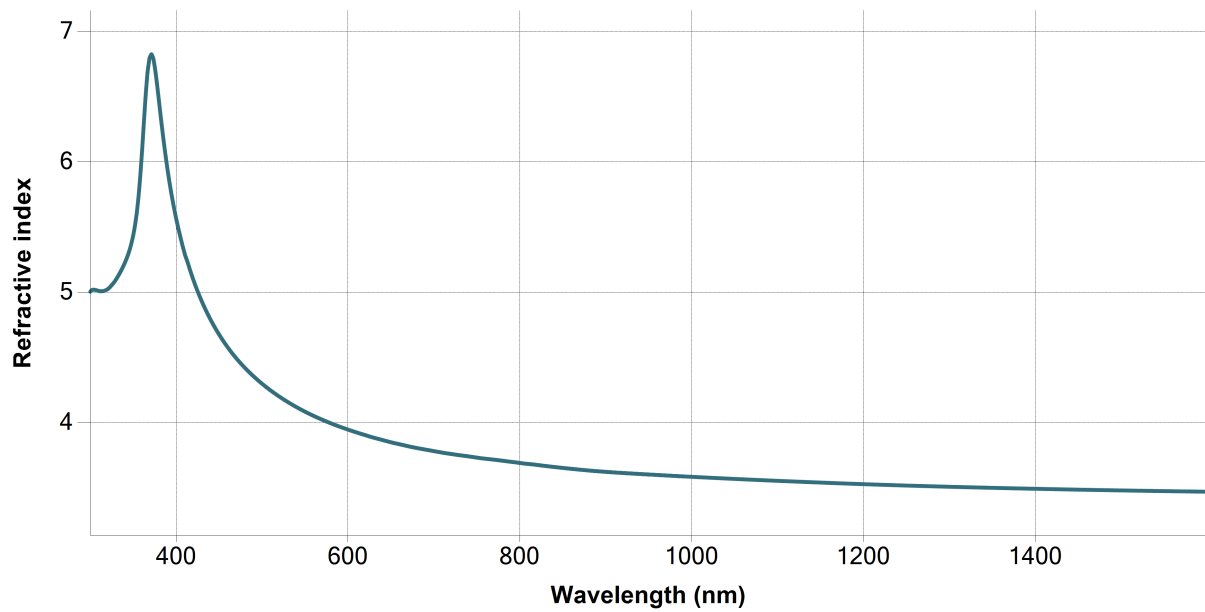
Correlation coefficients	
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[1] - f	0.2409
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[1] - E0 (eV)	0.2269
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[1] - Γ (eV)	0.3257
Ph2 - ITO_3 - Thickness --- Ph2 - Drude[2] - E_p (eV)	0.2141
Ph2 - ITO_3 - Thickness --- Ph2 - Drude[2] - E_Γ (eV)	0.0672
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[3] - f	-0.3047
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[3] - E0 (eV)	-0.3542
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[3] - Γ (eV)	-0.2007
Ph2 - ITO_3 - Thickness --- Ph2 - Eps_inf	0.3755
Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[1] - E0 (eV)	0.9309
Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[1] - Γ (eV)	0.8898
Ph2 - Lorentz[1] - f --- Ph2 - Drude[2] - E_p (eV)	0.3915
Ph2 - Lorentz[1] - f --- Ph2 - Drude[2] - E_Γ (eV)	-0.1943
Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[3] - f	-0.935
Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[3] - E0 (eV)	-0.4724
Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[3] - Γ (eV)	-0.9273
Ph2 - Lorentz[1] - f --- Ph2 - Eps_inf	0.614
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[1] - Γ (eV)	0.8993
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Drude[2] - E_p (eV)	0.3347
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Drude[2] - E_Γ (eV)	-0.2159
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[3] - f	-0.8379
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[3] - E0 (eV)	-0.3206
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[3] - Γ (eV)	-0.7909
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Eps_inf	0.5254
Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Drude[2] - E_p (eV)	0.3958
Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Drude[2] - E_Γ (eV)	-0.3408
Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Lorentz[3] - f	-0.7935
Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Lorentz[3] - E0 (eV)	-0.3872
Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Lorentz[3] - Γ (eV)	-0.7401
Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Eps_inf	0.5444
Ph2 - Drude[2] - E_p (eV) --- Ph2 - Drude[2] - E_Γ (eV)	-0.2311
Ph2 - Drude[2] - E_p (eV) --- Ph2 - Lorentz[3] - f	-0.4772
Ph2 - Drude[2] - E_p (eV) --- Ph2 - Lorentz[3] - E0 (eV)	-0.4313
Ph2 - Drude[2] - E_p (eV) --- Ph2 - Lorentz[3] - Γ (eV)	-0.3366
Ph2 - Drude[2] - E_p (eV) --- Ph2 - Eps_inf	0.7828
Ph2 - Drude[2] - E_Γ (eV) --- Ph2 - Lorentz[3] - f	0.0925
Ph2 - Drude[2] - E_Γ (eV) --- Ph2 - Lorentz[3] - E0 (eV)	-0.055
Ph2 - Drude[2] - E_Γ (eV) --- Ph2 - Lorentz[3] - Γ (eV)	0.0293
Ph2 - Drude[2] - E_Γ (eV) --- Ph2 - Eps_inf	-0.138
Ph2 - Lorentz[3] - f --- Ph2 - Lorentz[3] - E0 (eV)	0.6927
Ph2 - Lorentz[3] - f --- Ph2 - Lorentz[3] - Γ (eV)	0.9438
Ph2 - Lorentz[3] - f --- Ph2 - Eps_inf	-0.7959
Ph2 - Lorentz[3] - E0 (eV) --- Ph2 - Lorentz[3] - Γ (eV)	0.6257
Ph2 - Lorentz[3] - E0 (eV) --- Ph2 - Eps_inf	-0.7602
Ph2 - Lorentz[3] - Γ (eV) --- Ph2 - Eps_inf	-0.6296