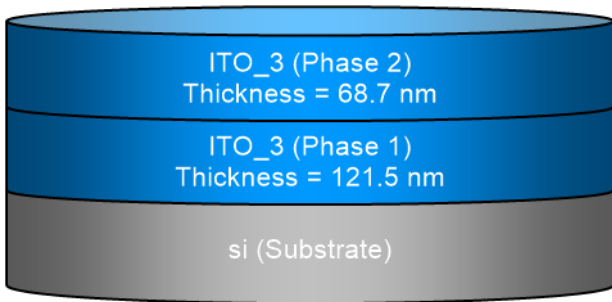


## SEA regression report summary

Sample ID
001-e-int-ii 70° 1
001-e-int-ii 65° 2
001-e-int-ii 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 14:25
Comments	

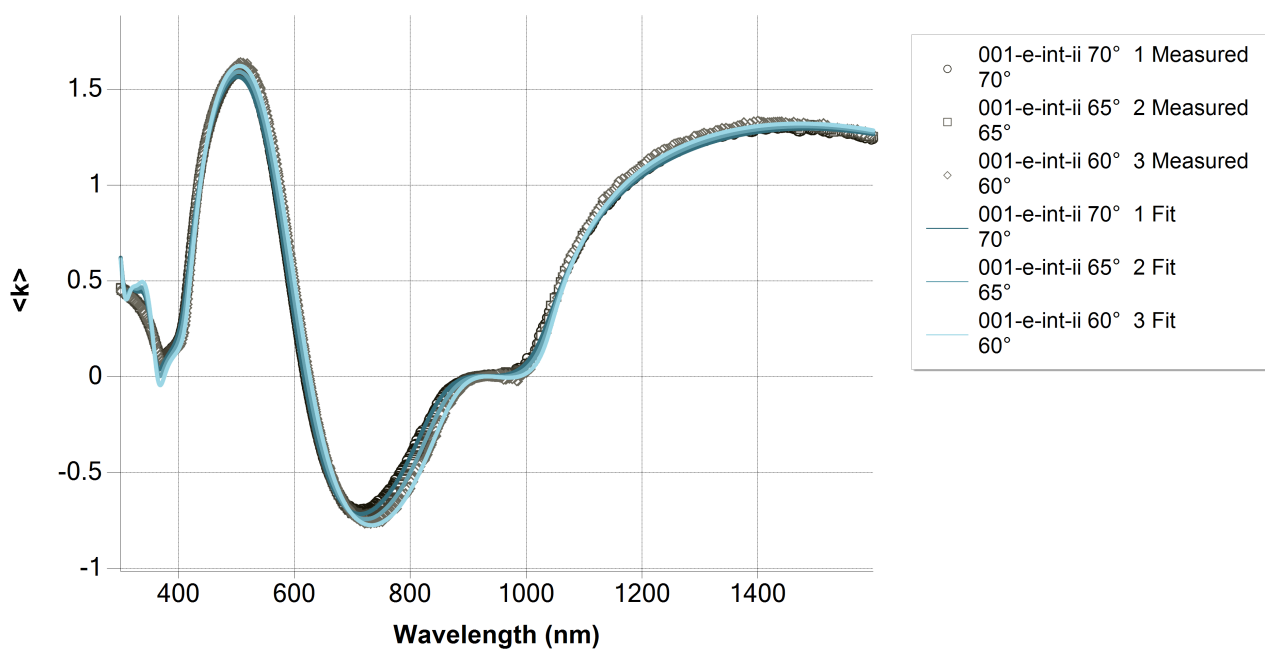
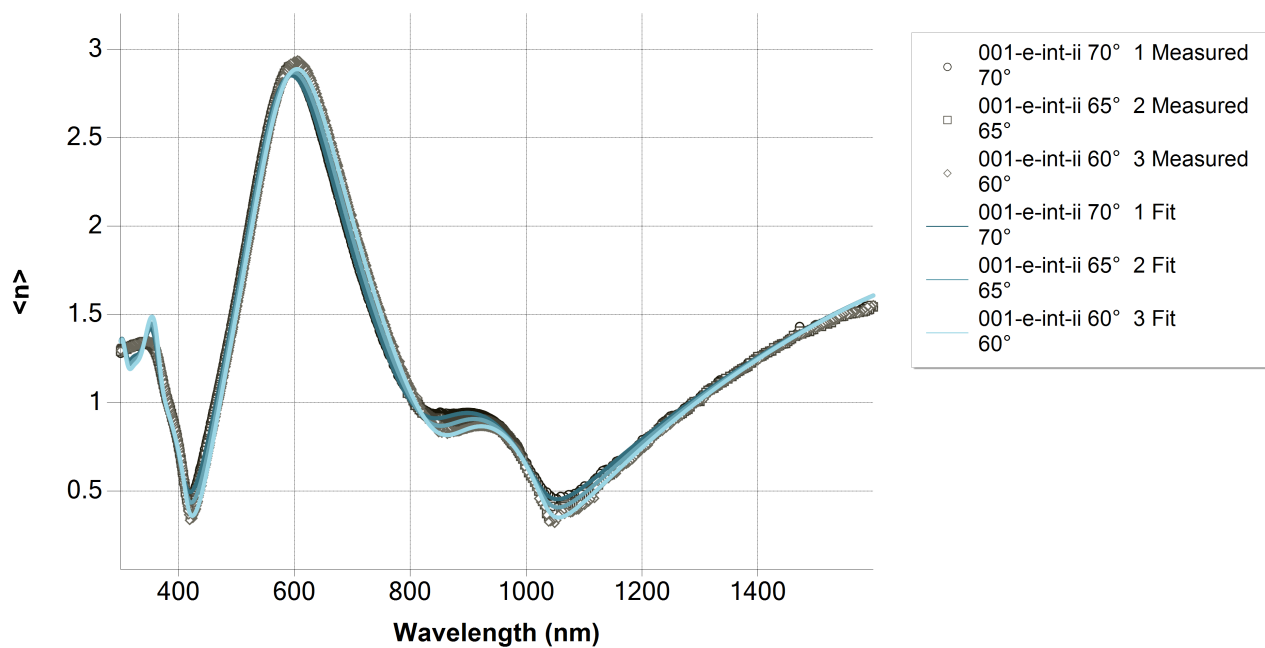
Layer structure	
Overview	
 <p>The diagram illustrates a three-layer structure. The top layer is labeled 'ITO_3 (Phase 2)' with a thickness of 68.7 nm. The middle layer is labeled 'ITO_3 (Phase 1)' with a thickness of 121.5 nm. The bottom layer is labeled 'si (Substrate)'.</p>	
Optical model	
Phase 2	ITO_3
Dispersion law	Lorentz
	Drude
	Lorentz
Phase 1	ITO_3
Dispersion law	Lorentz
	Drude
	Lorentz

## Regression results

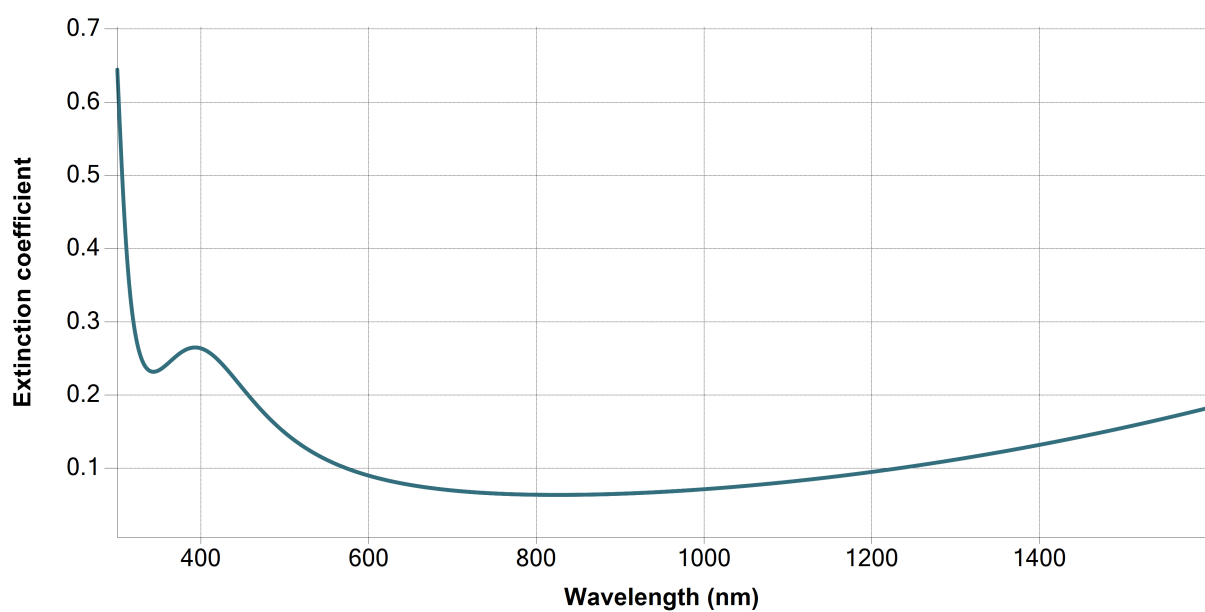
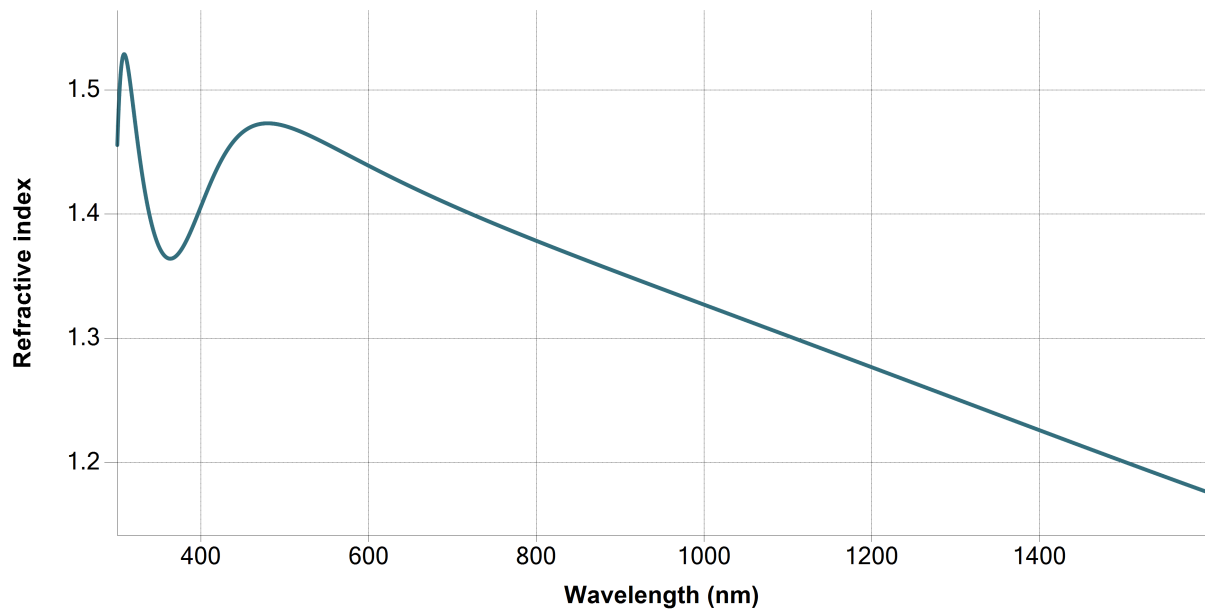
Measurement information				
Measurement 1				
Measurement file path	C:\Users\emmabat\ito-si\001-e-int-ii.smdx			
Angle of Incidence	70°			
Measurement 2				
Measurement file path	C:\Users\emmabat\ito-si\001-e-int-ii.smdx			
Angle of Incidence	65°			
Measurement 3				
Measurement file path	C:\Users\emmabat\ito-si\001-e-int-ii.smdx			
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	68.66	X	0.12509	nm
f	0.29898	X	0.0042466	
E0 (eV)	3.14233	X	0.0082426	eV
Γ (eV)	1.42207	X	0.016297	eV
E_p (eV)	0.73596	X	0.0055052	eV
E_Γ (eV)	0.43924	X	0.01089	eV
f	0.18311	X	0.0066616	
E0 (eV)	4.18905	X	0.0066117	eV
Γ (eV)	0.43363	X	0.016267	eV
Eps_inf	1.52968	X	0.011438	
Phase 1 (ITO_3)				
Thickness	121.494	X	0.12367	nm
f	0.16357			
E0 (eV)	3.74618			eV

$\Gamma$ (eV)	0.62015			eV
E_p (eV)	1.09856			eV
E_ $\Gamma$ (eV)	0.22823			eV
f	0.43808			
E0 (eV)	4.29829			eV
$\Gamma$ (eV)	0.24163			eV
Eps_inf	3.4998			
Derived parameters	Value			
Phase 2 (ITO_3)				
n @ 632.8 nm	1.4278			
k @ 632.8 nm	0.0808			
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)	1.6588E+04 $\pm$ 659.4266		S/m	
Resistivity (m $\Omega$ .cm)	6.0284 $\pm$ 0.2396		m $\Omega$ .cm	
Resistance ( $\Omega$ /sq)	878.0006 $\pm$ 36.5027		$\Omega$ /sq	
N type dopant concentration (at/cm3)	9.8206E+19 $\pm$ 1.4692E+18		at/cm3	
P type dopant concentration (at/cm3)	1.4535E+20 $\pm$ 2.1745E+18		at/cm3	
N type dopant mobility (cm2/Vs)	10.5426 $\pm$ 0.4478		cm2/Vs	
P type dopant mobility (cm2/Vs)	7.1234 $\pm$ 0.3026		cm2/Vs	
Phase 1 (ITO_3)				
Conductivity (S/m)	7.1131E+04 $\pm$ 0		S/m	
Resistivity (m $\Omega$ .cm)	1.4058 $\pm$ 0		m $\Omega$ .cm	
Resistance ( $\Omega$ /sq)	115.7135 $\pm$ 0.1178		$\Omega$ /sq	
N type dopant concentration (at/cm3)	2.1881E+20 $\pm$ 0		at/cm3	
P type dopant concentration (at/cm3)	3.2384E+20 $\pm$ 0		at/cm3	
N type dopant mobility (cm2/Vs)	20.2898 $\pm$ 0		cm2/Vs	
P type dopant mobility (cm2/Vs)	13.7093 $\pm$ 0		cm2/Vs	
Fit quality				
R^2	0.99806			
RMSE	0.03181			

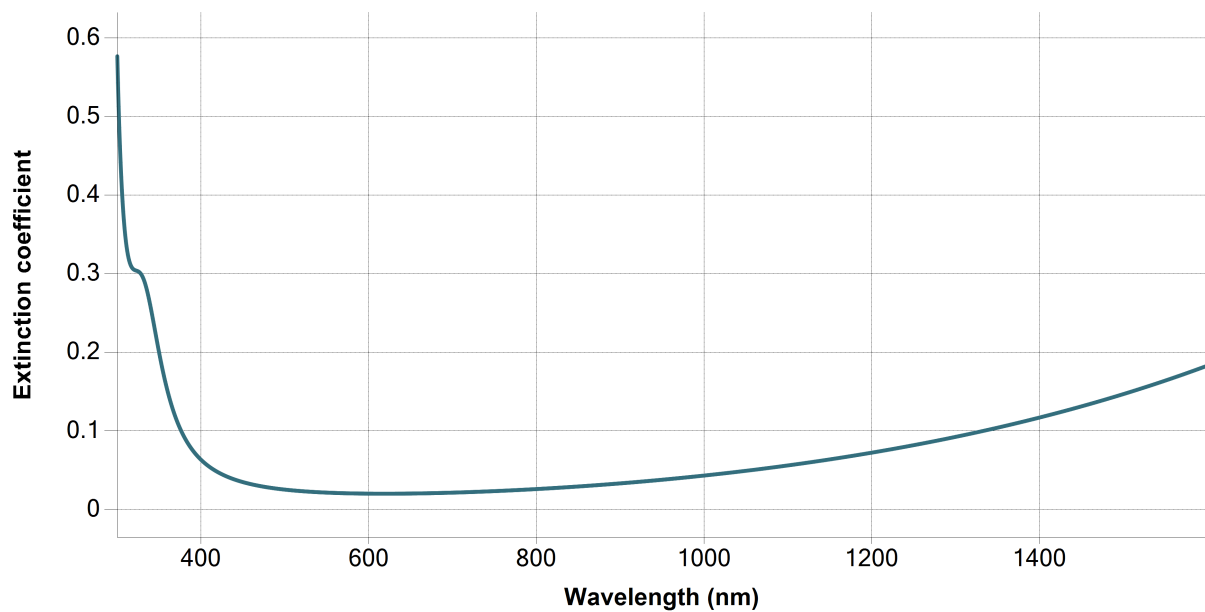
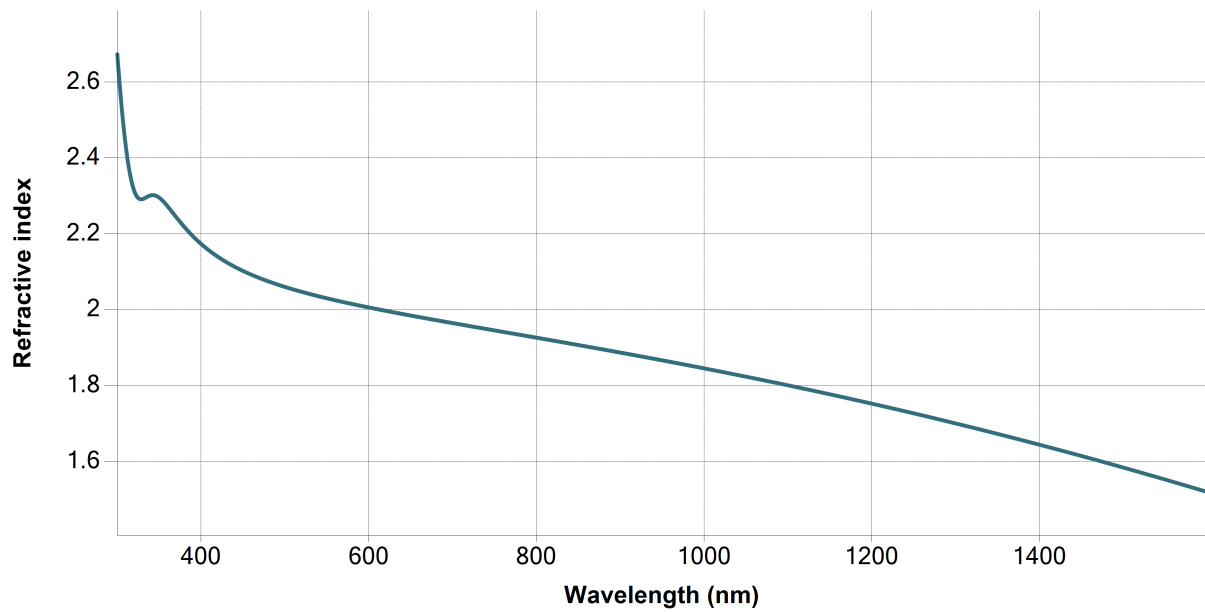
## Regression graphs



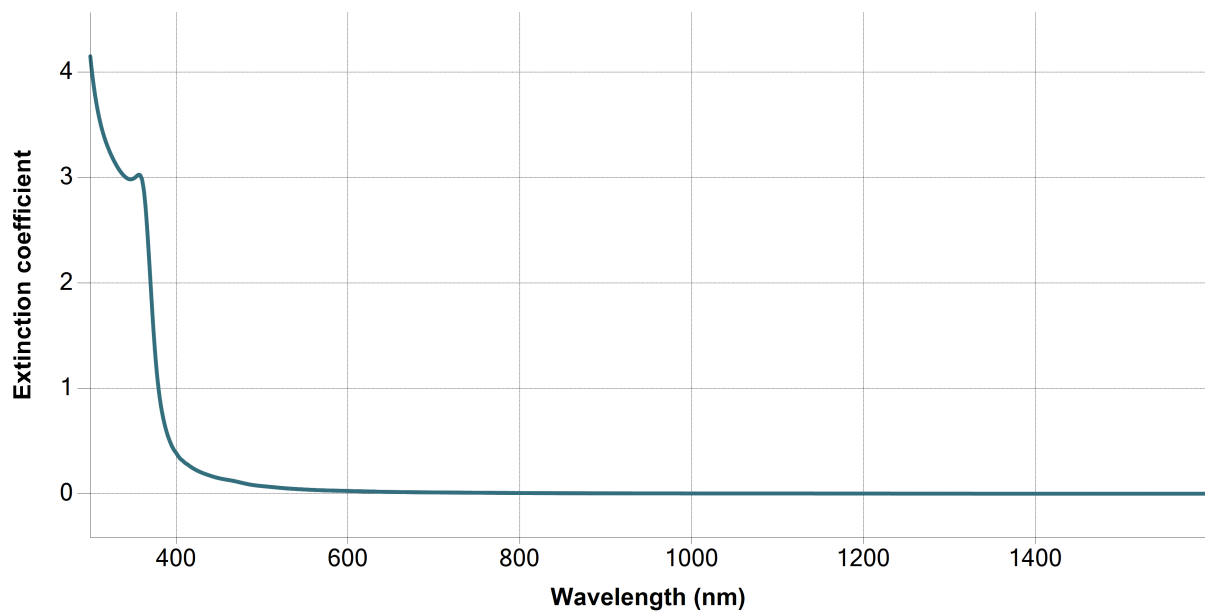
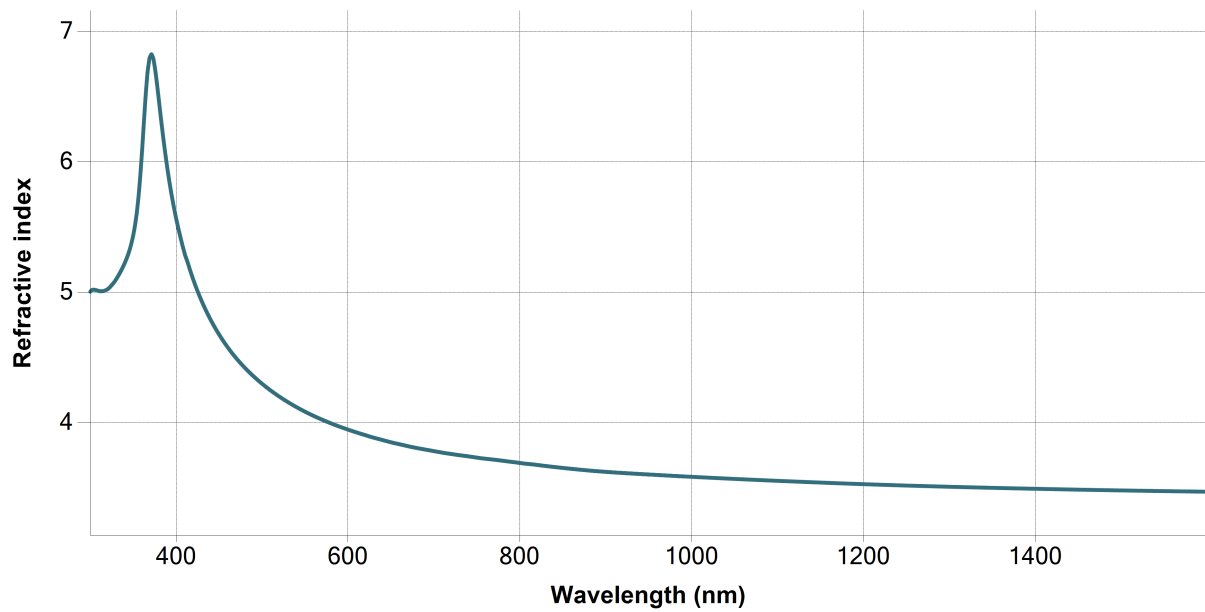
## Phase 2 (ITO\_3) - Dispersion graphs



## Phase 1 (ITO\_3) - Dispersion graphs



## Substrate (si) - Dispersion graphs



Correlation coefficients	
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[1] - f	-0.1397
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[1] - E0 (eV)	-0.1114
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[1] - $\Gamma$ (eV)	-0.0919
Ph2 - ITO_3 - Thickness --- Ph2 - Drude[2] - E_p (eV)	-0.3715
Ph2 - ITO_3 - Thickness --- Ph2 - Drude[2] - E_ $\Gamma$ (eV)	0.164
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[3] - f	0.099
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[3] - E0 (eV)	0.028
Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[3] - $\Gamma$ (eV)	0.1451
Ph2 - ITO_3 - Thickness --- Ph2 - Eps_inf	-0.2736
Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[1] - E0 (eV)	0.9001
Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[1] - $\Gamma$ (eV)	0.8809
Ph2 - Lorentz[1] - f --- Ph2 - Drude[2] - E_p (eV)	0.3769
Ph2 - Lorentz[1] - f --- Ph2 - Drude[2] - E_ $\Gamma$ (eV)	-0.5116
Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[3] - f	-0.7597
Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[3] - E0 (eV)	-0.507
Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[3] - $\Gamma$ (eV)	-0.743
Ph2 - Lorentz[1] - f --- Ph2 - Eps_inf	0.5666
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[1] - $\Gamma$ (eV)	0.8271
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Drude[2] - E_p (eV)	0.2486
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Drude[2] - E_ $\Gamma$ (eV)	-0.3622
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[3] - f	-0.7396
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[3] - E0 (eV)	-0.4767
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[3] - $\Gamma$ (eV)	-0.7206
Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Eps_inf	0.4587
Ph2 - Lorentz[1] - $\Gamma$ (eV) --- Ph2 - Drude[2] - E_p (eV)	0.2281
Ph2 - Lorentz[1] - $\Gamma$ (eV) --- Ph2 - Drude[2] - E_ $\Gamma$ (eV)	-0.5265
Ph2 - Lorentz[1] - $\Gamma$ (eV) --- Ph2 - Lorentz[3] - f	-0.5365
Ph2 - Lorentz[1] - $\Gamma$ (eV) --- Ph2 - Lorentz[3] - E0 (eV)	-0.3092
Ph2 - Lorentz[1] - $\Gamma$ (eV) --- Ph2 - Lorentz[3] - $\Gamma$ (eV)	-0.5101
Ph2 - Lorentz[1] - $\Gamma$ (eV) --- Ph2 - Eps_inf	0.3453
Ph2 - Drude[2] - E_p (eV) --- Ph2 - Drude[2] - E_ $\Gamma$ (eV)	-0.1937
Ph2 - Drude[2] - E_p (eV) --- Ph2 - Lorentz[3] - f	-0.5294
Ph2 - Drude[2] - E_p (eV) --- Ph2 - Lorentz[3] - E0 (eV)	-0.4183
Ph2 - Drude[2] - E_p (eV) --- Ph2 - Lorentz[3] - $\Gamma$ (eV)	-0.3829
Ph2 - Drude[2] - E_p (eV) --- Ph2 - Eps_inf	0.7989
Ph2 - Drude[2] - E_ $\Gamma$ (eV) --- Ph2 - Lorentz[3] - f	0.3254
Ph2 - Drude[2] - E_ $\Gamma$ (eV) --- Ph2 - Lorentz[3] - E0 (eV)	0.2029
Ph2 - Drude[2] - E_ $\Gamma$ (eV) --- Ph2 - Lorentz[3] - $\Gamma$ (eV)	0.2786
Ph2 - Drude[2] - E_ $\Gamma$ (eV) --- Ph2 - Eps_inf	-0.3168
Ph2 - Lorentz[3] - f --- Ph2 - Lorentz[3] - E0 (eV)	0.8346
Ph2 - Lorentz[3] - f --- Ph2 - Lorentz[3] - $\Gamma$ (eV)	0.8823
Ph2 - Lorentz[3] - f --- Ph2 - Eps_inf	-0.8197
Ph2 - Lorentz[3] - E0 (eV) --- Ph2 - Lorentz[3] - $\Gamma$ (eV)	0.7491
Ph2 - Lorentz[3] - E0 (eV) --- Ph2 - Eps_inf	-0.6765
Ph2 - Lorentz[3] - $\Gamma$ (eV) --- Ph2 - Eps_inf	-0.6161



