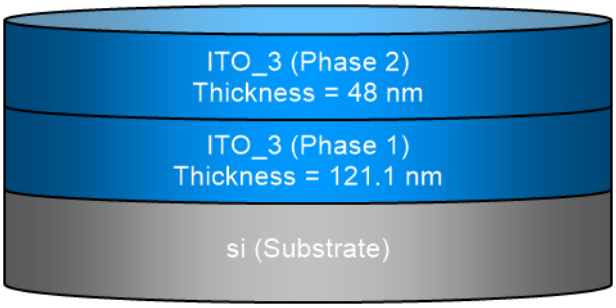
# SEA regression report summary

| Sample ID |
|---|
| **001d-int-i 70° 1** |
| **001d-int-i 65° 2** |
| **001d-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 14:22 |
| Comments | |

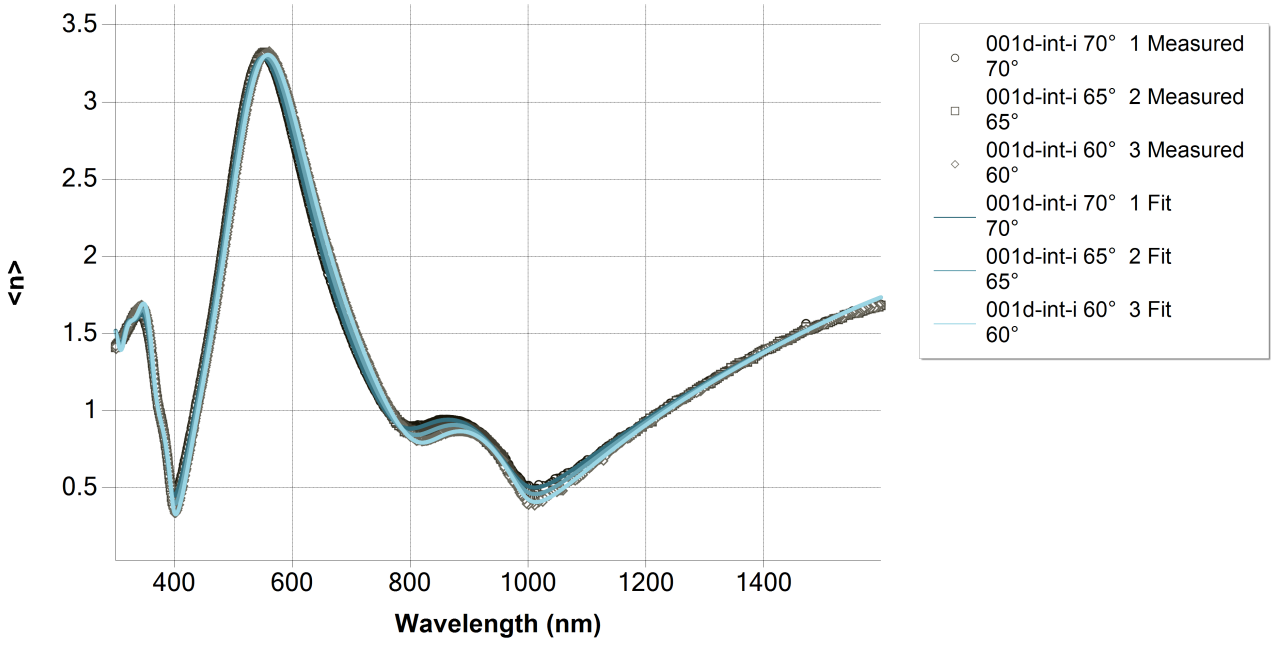
| Layer structure | |
|---|---|
| **Overview** | |
|  | |
| **Optical model** | |
| Phase 2 | ITO_3 |
| Dispersion law | Lorentz |
| | Drude |
| | Lorentz |
| Phase 1 | ITO_3 |
| Dispersion law | Lorentz |
| | Drude |
| | Lorentz |

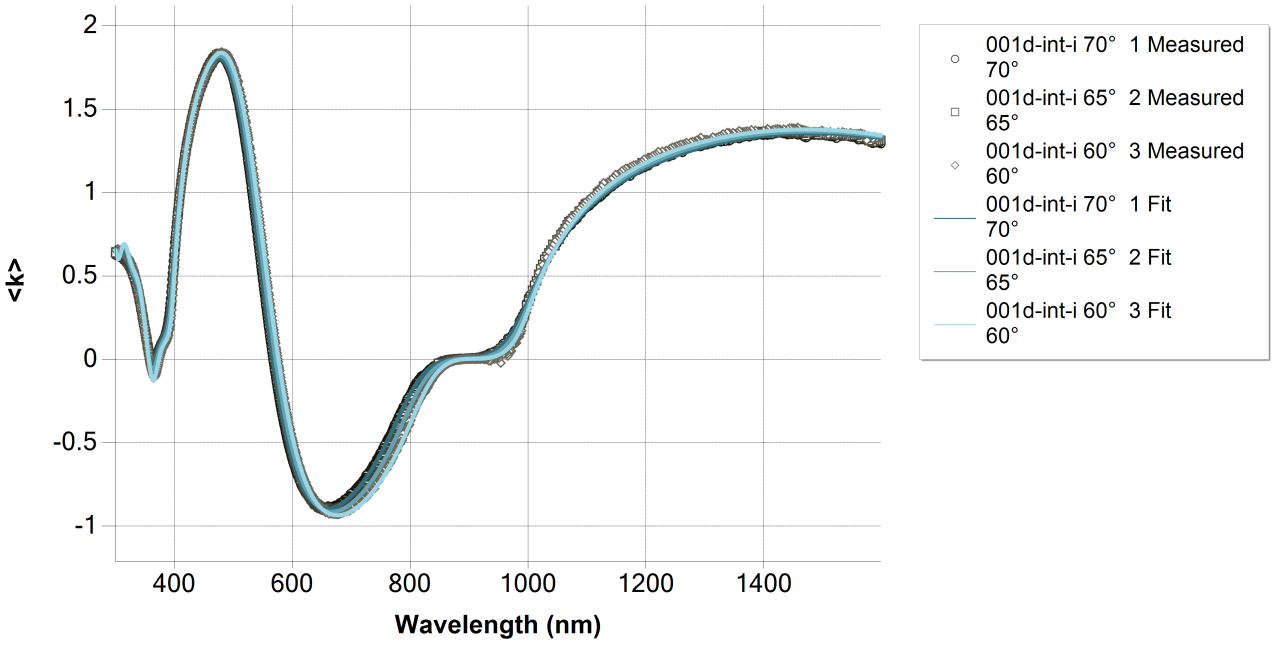
## Regression results

| Measurement information | | | | |
|---|---|---|---|---|
| Measurement 1 | | | | |
| Measurement file path | C:\Users\emmabat\ito-si\001d-int-i.smdx | | | |
| Angle of Incidence | 70° | | | |
| Measurement 2 | | | | |
| Measurement file path | C:\Users\emmabat\ito-si\001d-int-i.smdx | | | |
| Angle of Incidence | 65° | | | |
| Measurement 3 | | | | |
| Measurement file path | C:\Users\emmabat\ito-si\001d-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 | 47.957 | X | 0.052677 | nm |
| f | 0.13578 | X | 0.0026014 | |
| E0 (eV) | 3.27928 | X | 0.0056024 | eV |
| Γ (eV) | 0.92833 | X | 0.010389 | eV |
| E_p (eV) | 0.65742 | X | 0.0040607 | eV |
| E_Γ (eV) | 0.43796 | X | 0.0075337 | eV |
| f | 0.35029 | X | 0.0057661 | |
| E0 (eV) | 4.30009 | X | 0.005076 | eV |
| Γ (eV) | 0.54646 | X | 0.010766 | eV |
| Eps_inf | 1.44172 | X | 0.0087107 | |
| Phase 1 (ITO_3) | | | | |
| Thickness | 121.073 | X | 0.06321 | nm |
| f | 0.16357 | | | |
| E0 (eV) | 3.74618 | | | eV |

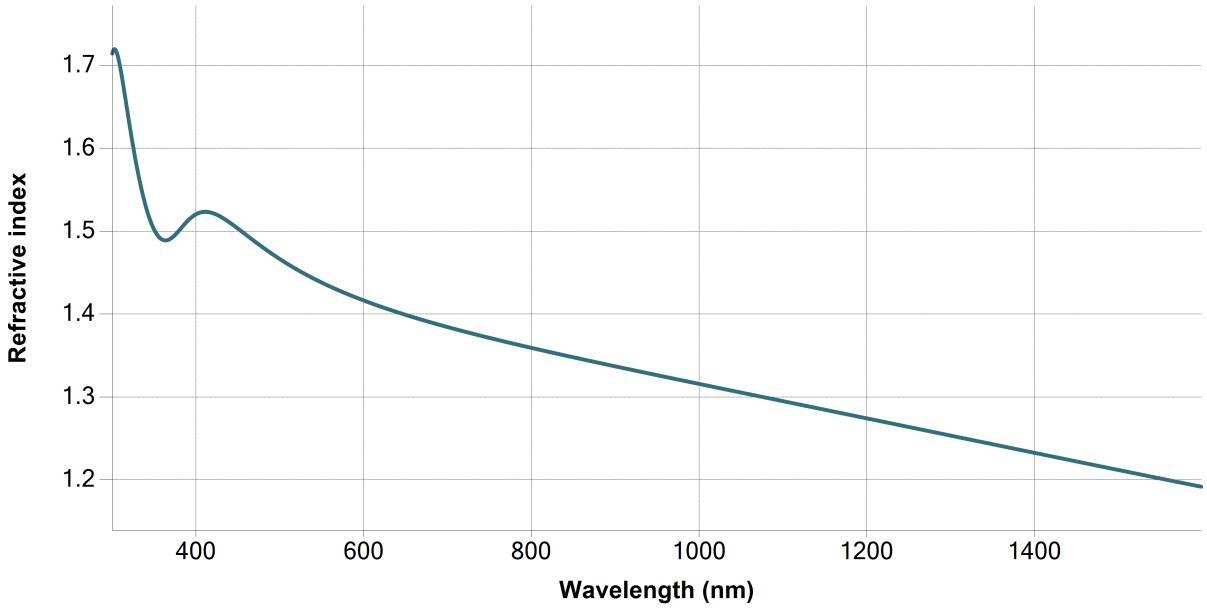
| | | | | |
|---|---|---|---|---|
| Γ (eV) | 0.62015 | | | eV |
| E_p (eV) | 1.09856 | | | eV |
| E_Γ (eV) | 0.22823 | | | eV |
| f | 0.43808 | | | |
| E0 (eV) | 4.29829 | | | eV |
| Γ (eV) | 0.24163 | | | eV |
| Eps_inf | 3.4998 | | | |
| Derived parameters | Value | | | |
| Phase 2 (ITO_3) | | | | |
| n @ 632.8 nm | 1.4047 | | | |
| k @ 632.8 nm | 0.0385 | | | |
| 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) | 1.3275E+04 ± 392.3405 | | | S/m |
| Resistivity (mΩ.cm) | 7.533 ± 0.2226 | | | mΩ.cm |
| Resistance (Ω/sq) | 1570.7753 ± 48.1498 | | | Ω/sq |
| N type dopant concentration (at/cm3) | 7.8363E+19 ± 9.6805E+17 | | | at/cm3 |
| P type dopant concentration (at/cm3) | 1.1598E+20 ± 1.4327E+18 | | | at/cm3 |
| N type dopant mobility (cm2/Vs) | 10.5733 ± 0.3387 | | | cm2/Vs |
| P type dopant mobility (cm2/Vs) | 7.1441 ± 0.2288 | | | 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) | 116.1158 ± 0.0606 | | | 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 | 0.99965 | | | |
| RMSE | 0.0154 | | | |

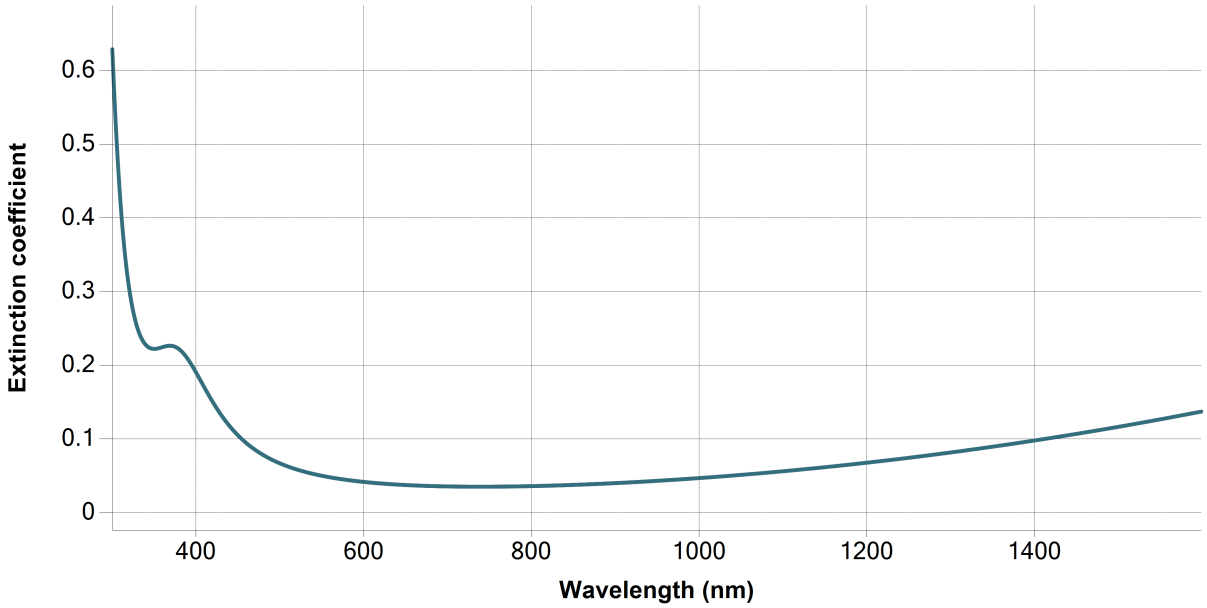
## Regression graphs



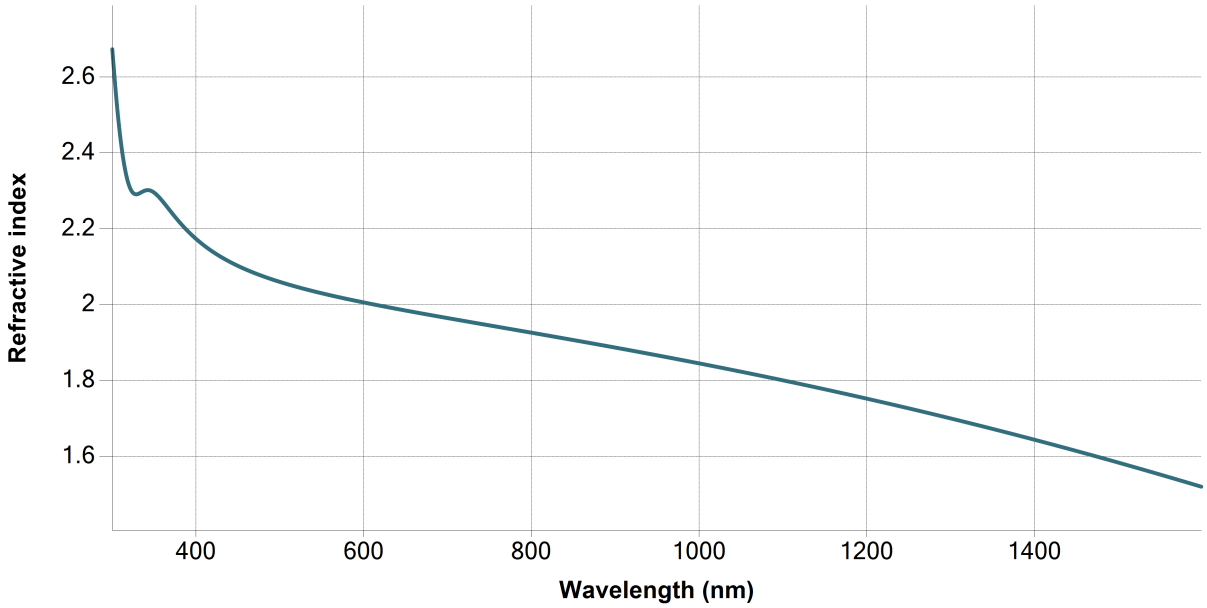



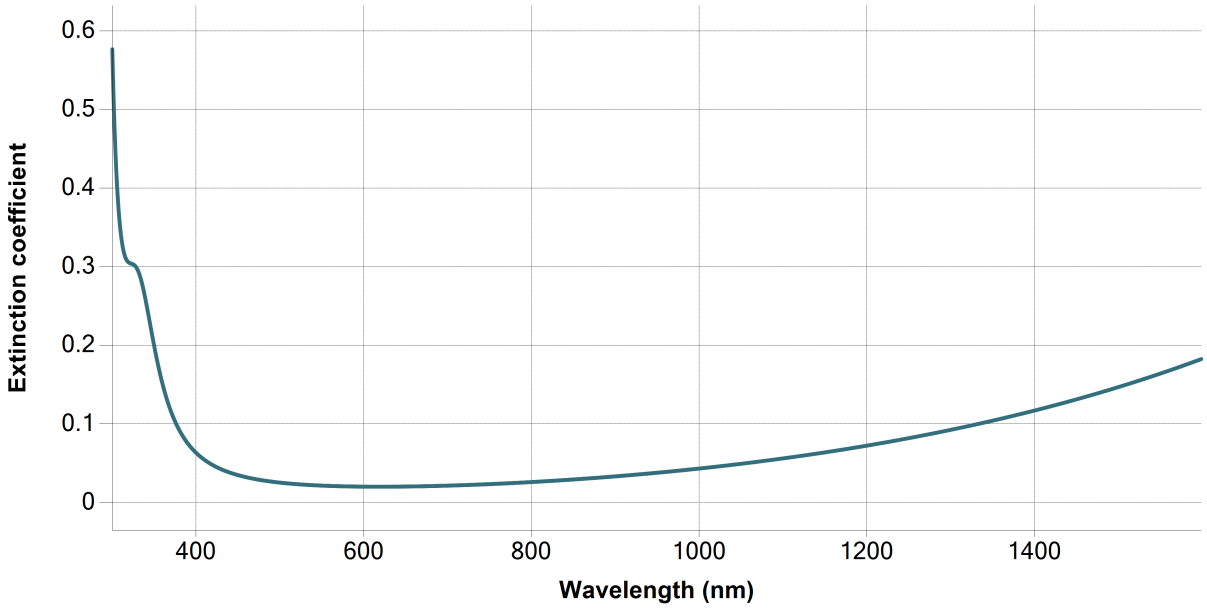
## Phase 2 (ITO_3) - Dispersion graphs



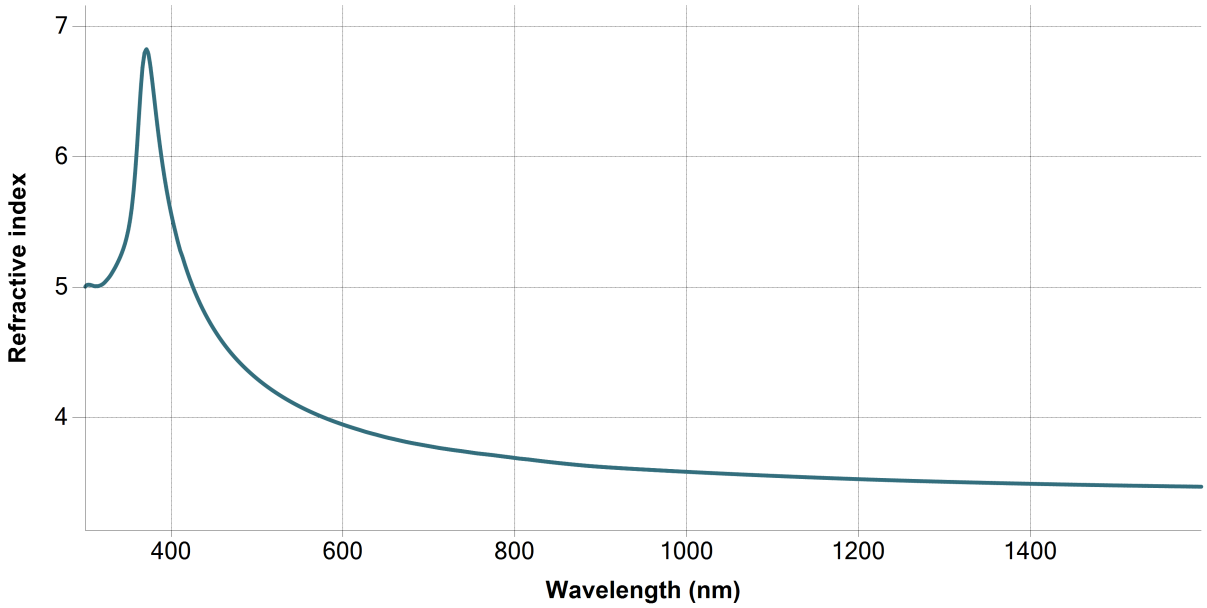



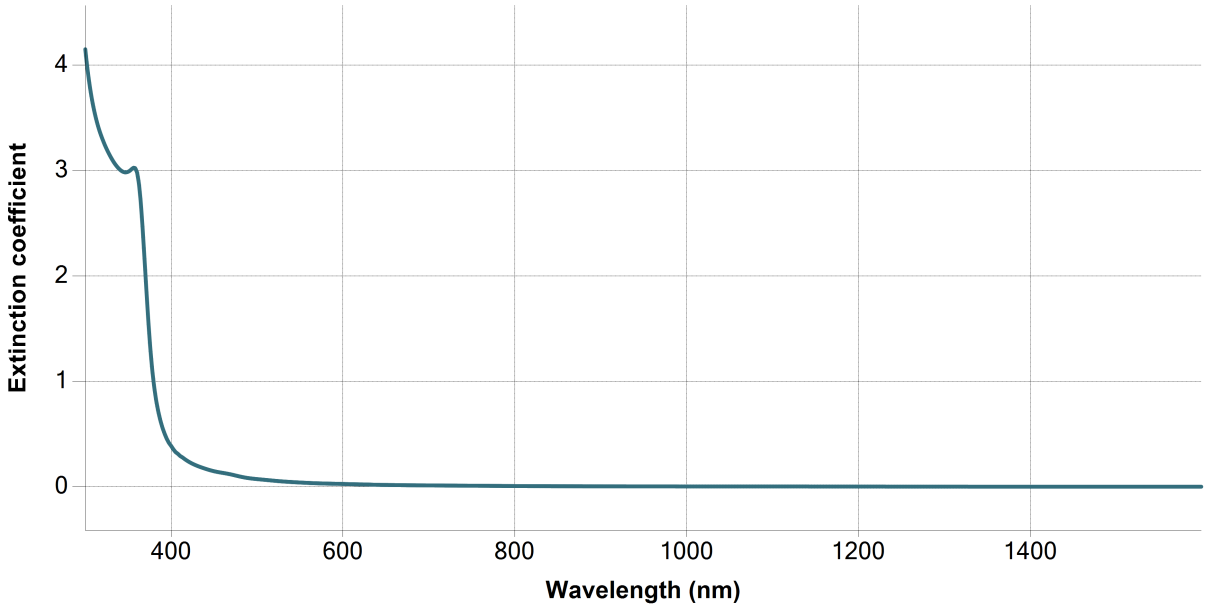
## Phase 1 (ITO_3) - Dispersion graphs



## Substrate (si) - Dispersion graphs



| Correlation coefficients | |
|---|---|
| Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[1] - f | -0.1589 |
| Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[1] - E0 (eV) | -0.1571 |
| Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[1] - Γ (eV) | -0.1243 |
| Ph2 - ITO_3 - Thickness --- Ph2 - Drude[2] - E_p (eV) | -0.3387 |
| Ph2 - ITO_3 - Thickness --- Ph2 - Drude[2] - E_Γ (eV) | 0.1855 |
| Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[3] - f | 0.1321 |
| Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[3] - E0 (eV) | -0.0239 |
| Ph2 - ITO_3 - Thickness --- Ph2 - Lorentz[3] - Γ (eV) | 0.1611 |
| Ph2 - ITO_3 - Thickness --- Ph2 - Eps_inf | -0.2297 |
| Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[1] - E0 (eV) | 0.9226 |
| Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[1] - Γ (eV) | 0.8693 |
| Ph2 - Lorentz[1] - f --- Ph2 - Drude[2] - E_p (eV) | 0.4206 |
| Ph2 - Lorentz[1] - f --- Ph2 - Drude[2] - E_Γ (eV) | -0.2823 |
| Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[3] - f | -0.8331 |
| Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[3] - E0 (eV) | -0.616 |
| Ph2 - Lorentz[1] - f --- Ph2 - Lorentz[3] - Γ (eV) | -0.8507 |
| Ph2 - Lorentz[1] - f --- Ph2 - Eps_inf | 0.6022 |
| Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[1] - Γ (eV) | 0.8417 |
| Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Drude[2] - E_p (eV) | 0.3757 |
| Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Drude[2] - E_Γ (eV) | -0.2425 |
| Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[3] - f | -0.7617 |
| Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[3] - E0 (eV) | -0.5142 |
| Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Lorentz[3] - Γ (eV) | -0.7254 |
| Ph2 - Lorentz[1] - E0 (eV) --- Ph2 - Eps_inf | 0.5573 |
| Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Drude[2] - E_p (eV) | 0.3013 |
| Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Drude[2] - E_Γ (eV) | -0.3365 |
| Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Lorentz[3] - f | -0.5957 |
| Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Lorentz[3] - E0 (eV) | -0.4037 |
| Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Lorentz[3] - Γ (eV) | -0.6218 |
| Ph2 - Lorentz[1] - Γ (eV) --- Ph2 - Eps_inf | 0.3998 |
| Ph2 - Drude[2] - E_p (eV) --- Ph2 - Drude[2] - E_Γ (eV) | -0.1764 |
| Ph2 - Drude[2] - E_p (eV) --- Ph2 - Lorentz[3] - f | -0.5703 |
| Ph2 - Drude[2] - E_p (eV) --- Ph2 - Lorentz[3] - E0 (eV) | -0.4049 |
| Ph2 - Drude[2] - E_p (eV) --- Ph2 - Lorentz[3] - Γ (eV) | -0.3264 |
| Ph2 - Drude[2] - E_p (eV) --- Ph2 - Eps_inf | 0.8168 |
| Ph2 - Drude[2] - E_Γ (eV) --- Ph2 - Lorentz[3] - f | 0.2022 |
| Ph2 - Drude[2] - E_Γ (eV) --- Ph2 - Lorentz[3] - E0 (eV) | 0.0958 |
| Ph2 - Drude[2] - E_Γ (eV) --- Ph2 - Lorentz[3] - Γ (eV) | 0.1144 |
| Ph2 - Drude[2] - E_Γ (eV) --- Ph2 - Eps_inf | -0.2716 |
| Ph2 - Lorentz[3] - f --- Ph2 - Lorentz[3] - E0 (eV) | 0.8624 |
| Ph2 - Lorentz[3] - f --- Ph2 - Lorentz[3] - Γ (eV) | 0.8459 |
| Ph2 - Lorentz[3] - f --- Ph2 - Eps_inf | -0.8237 |
| Ph2 - Lorentz[3] - E0 (eV) --- Ph2 - Lorentz[3] - Γ (eV) | 0.7445 |
| Ph2 - Lorentz[3] - E0 (eV) --- Ph2 - Eps_inf | -0.6655 |
| Ph2 - Lorentz[3] - Γ (eV) --- Ph2 - Eps_inf | -0.5126 |