CODE software generation 4

Easy, enhanced and elegant optical thin film analysis and design

W.Theiss Hard- and Software

Optical modeling for understanding thin film properties
Excellent modeling capabilities
Flexible graphical user interfaces
Remote control by OLE automation

CODE 4

Software for optical thin film analysis and design

W.Theiss Hard- and Software

Example: Develop solution for touch display problem

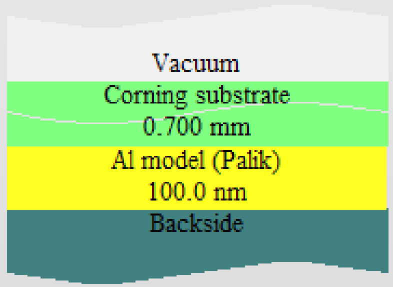
- Investigate MoOx as candidate material: Systematic oxygen variation
- Develop powerful optical constant model for MoOx
- Design: Optimize stoichiometry and thickness
- Production control

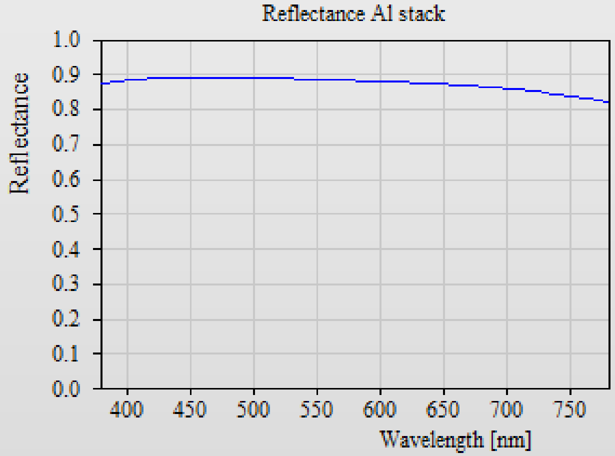
Touch displays

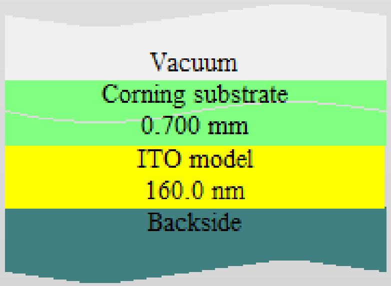
Aluminum bridges are visible due to high reflectance

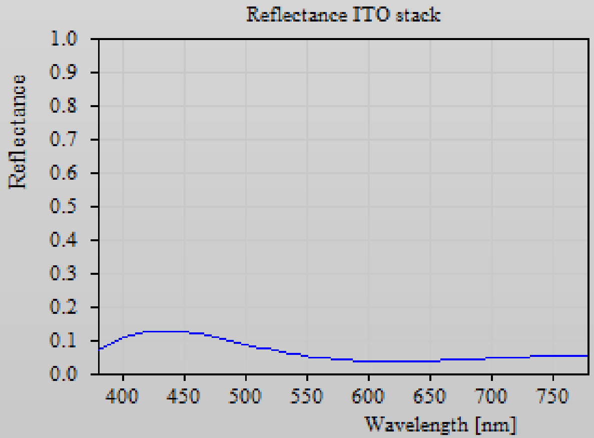
AR coating between glass and Aluminum is needed

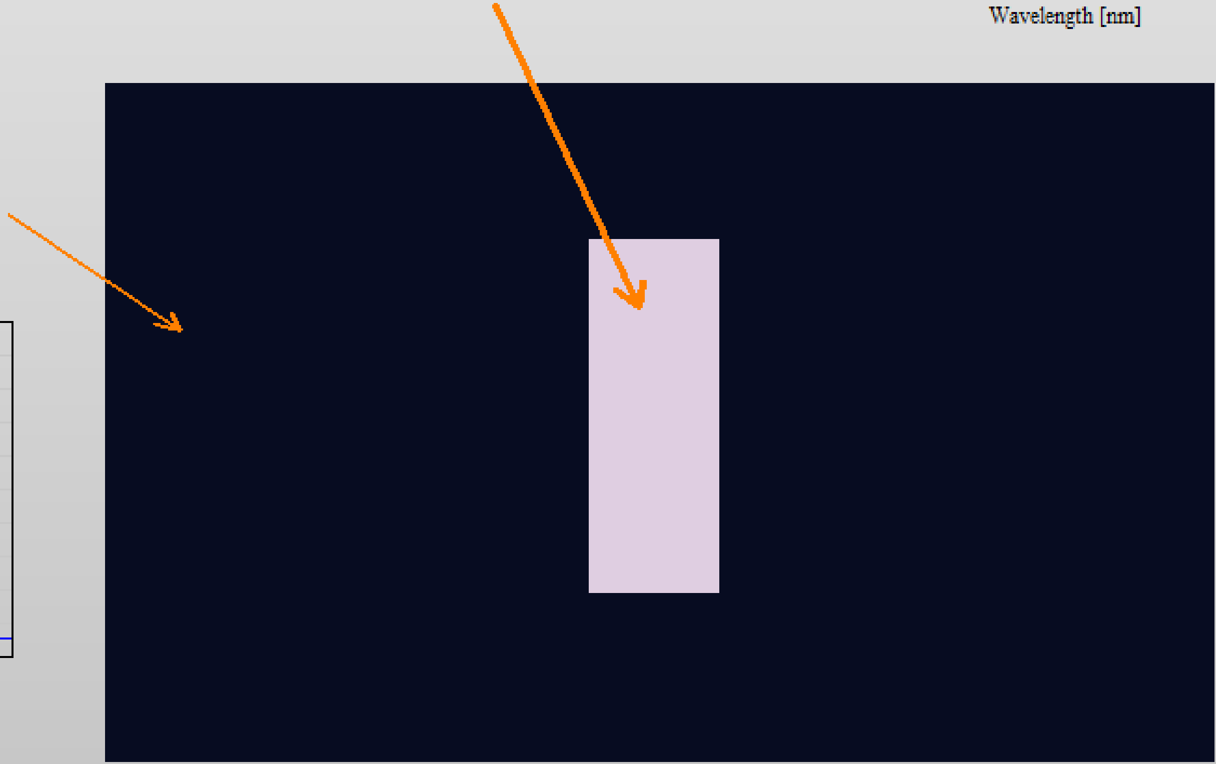
Candidate material: MoOx
(Co-operation with Plansee: J.Winkler, H. Köstenbauer)











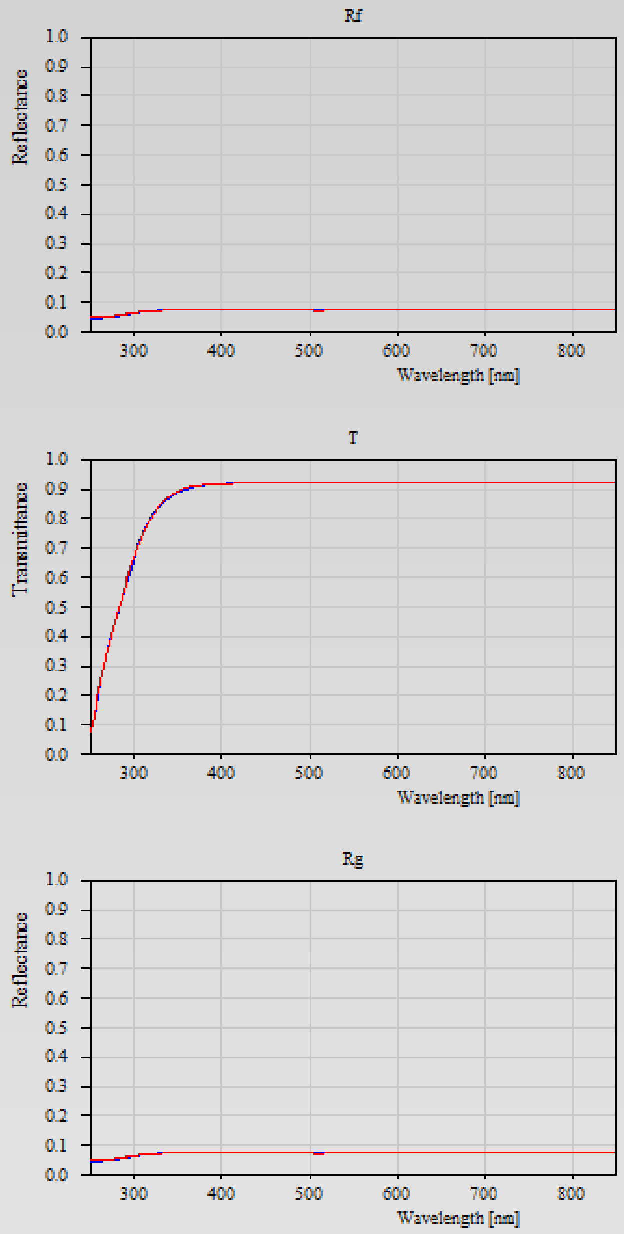
First things first:
Determine optical constants of substrate (Corning glass)

Sample:	Corning glass
Fit deviation:	0.0000046
Rating:	Excellent

Fit parameters:

D		4.1356	Corning substrate:OJL2: Strength	
D		59269.8906	Corning substrate:OJL2: Gap energy	
D		2122.5981	Corning substrate:OJL2: Gamma	
D		0.0047	Corning substrate:kim 3000: oscillator strength	
D		12.5534	Corning substrate:kim 4500: oscillator strength	
D		0.0000	Corning substrate:kim 5080: oscillator strength	
D		0.0001	Corning substrate:kim 7000: oscillator strength	
D		10.0736	Corning substrate:kim 9300: oscillator strength	
D		0.0185	Corning substrate:kim 21000: oscillator strength	
D		0.0001	Corning substrate:kim 23000: oscillator strength	
D		90.6350	Corning substrate:kim 26000: oscillator strength	
D		14009.2832	Corning substrate:kim UV: oscillator strength	
D		1.8666	Corning substrate:DB: real part	
D		12628.0029	Corning substrate:OJL2: Decay	
D		36298.9805	Corning substrate:kim 26000: resonance frequency	
D		7485.7080	Corning substrate:kim 26000: damping	

Vacuum
Corning substrate
0.700 mm
Vacuum



MoOx on Corning glass

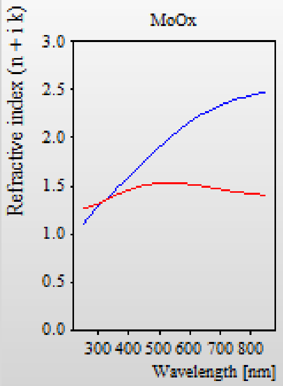
Analyze R and T spectra of single layer on glass
Get optical constants and thickness

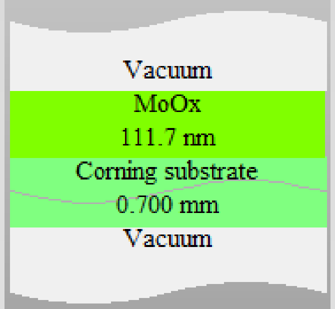
Loop through batch results

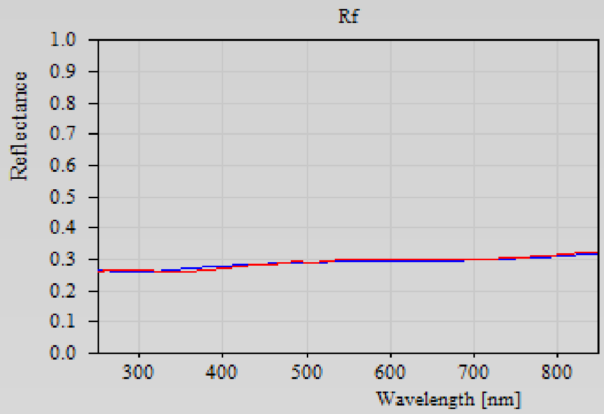
Sample: 3.5*10-4 mbar
Fit deviation 0.0001377
Rating: Acceptable

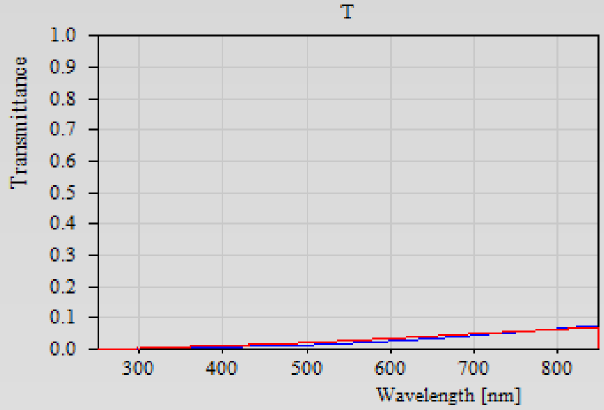
Fit parameters:

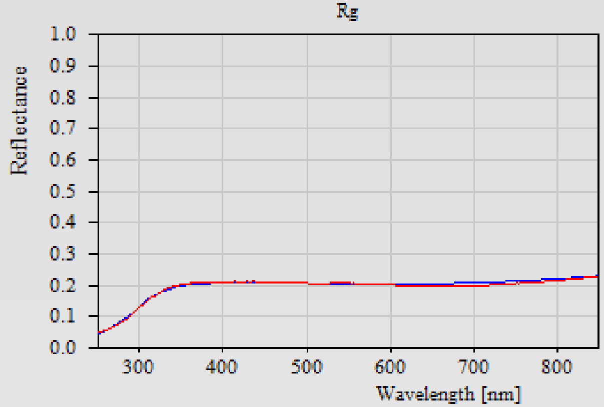
D		33596.5156	MoOx:Dr: plasma frequency	
D		26856.2285	MoOx:Dr: damping	
D		18659.7656	MoOx:K1: resonance frequency	
D		25855.1289	MoOx:K1: oscillator strength	
D		17233.2383	MoOx:K1: damping	
D		0.0638	MoOx:OJL: Strength	
D		10000.0000	MoOx:OJL: Gap energy	
D		22538.4727	MoOx:OJL: Gamma	
D		26940.6953	MoOx:OJL: Decay	
D		1.0000000	MoOx:n0	
D		111.7	Stack 1 Layer 2 MoOx: Layer thickness	











MoOx on Corning glass

Analyze R and T spectra of single layer on glass

Get optical constants and thickness

Loop through batch results

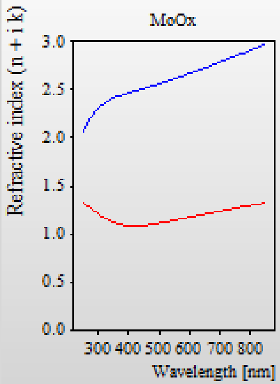
Sample: 4.5*10-4 mbar

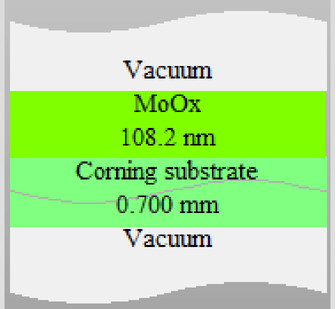
Fit deviation: 0.0001759

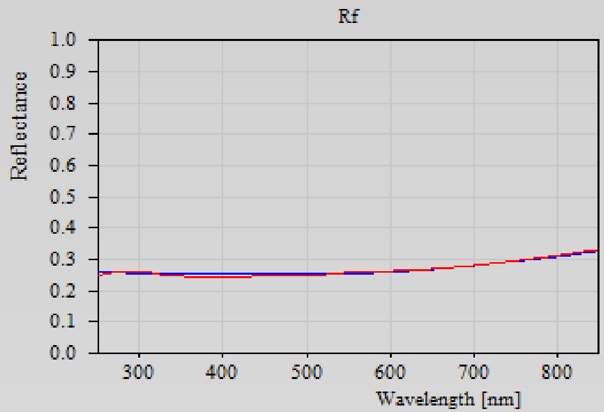
Rating: Acceptable

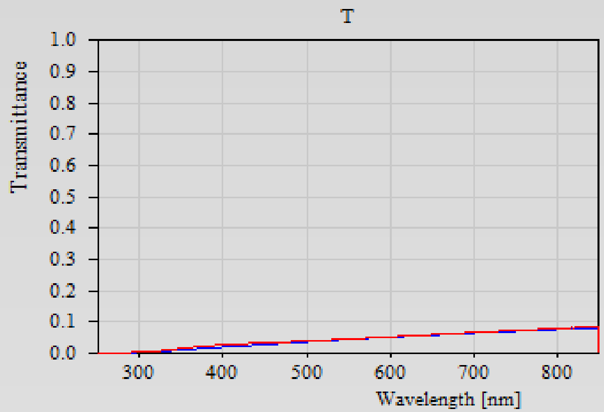
Fit parameters:

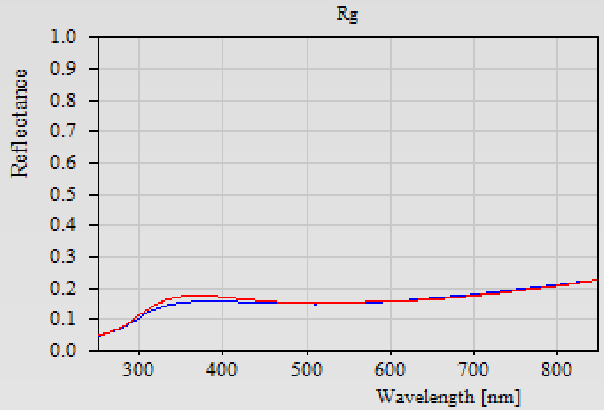
D	12428.2324	MoOx:Dr: plasma frequency	
D	17100.2246	MoOx:Dr: damping	
D	10675.2266	MoOx:K1: resonance frequency	
D	35009.3359	MoOx:K1: oscillator strength	
D	19987.7539	MoOx:K1: damping	
D	0.4430	MoOx:OJL: Strength	
D	15729.9570	MoOx:OJL: Gap energy	
D	9841.1973	MoOx:OJL: Gamma	
D	30000.0000	MoOx:OJL: Decay	
D	1.7444198	MoOx:n0	
D	108.2	Stack 1 Layer 2 MoOx: Layer thickness	











MoOx on Corning glass

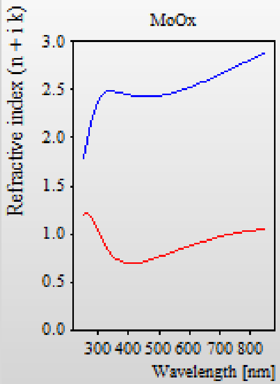
Analyze R and T spectra of single layer on glass
Get optical constants and thickness

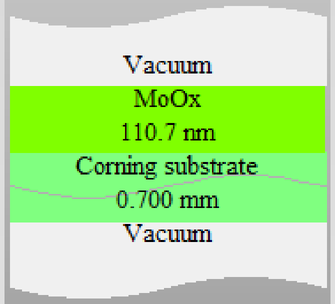
Loop through batch results

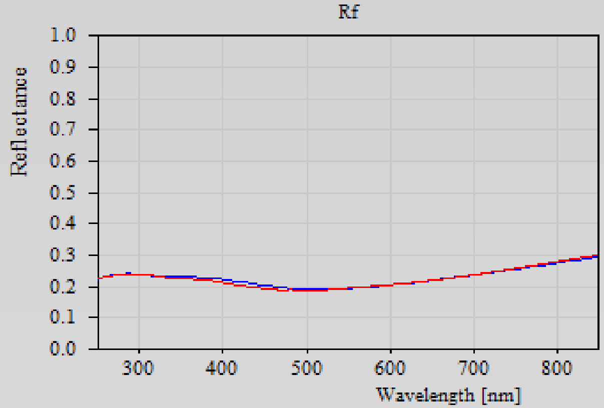
Sample: 5.5*10-4 mbar
Fit deviation: 0.0002408
Rating: Acceptable

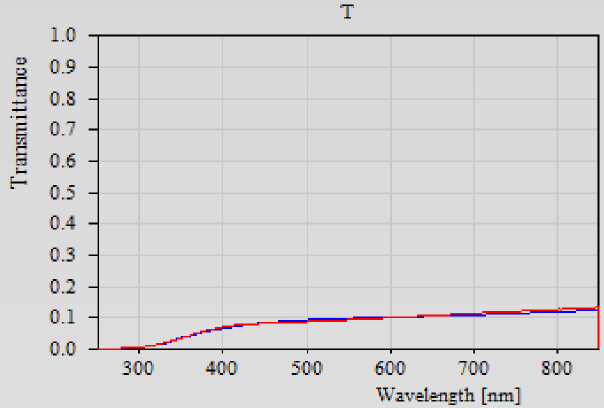
Fit parameters:

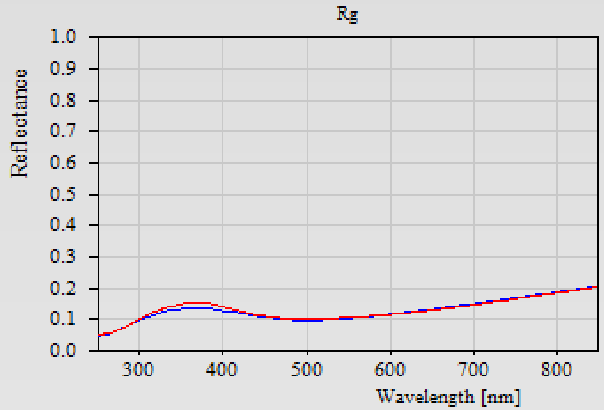
D	0.0000	MoOx:Dr: plasma frequency
D	18097.3027	MoOx:Dr: damping
D	12655.4873	MoOx:K1: resonance frequency
D	36322.8750	MoOx:K1: oscillator strength
D	19531.4043	MoOx:K1: damping
D	1.5902	MoOx:OJL: Strength
D	25137.8789	MoOx:OJL: Gap energy
D	5187.4937	MoOx:OJL: Gamma
D	11665.3906	MoOx:OJL: Decay
D	2.0923479	MoOx:n0
D	110.7	Stack 1 Layer 2 MoOx: Layer thickness











MoOx on Corning glass

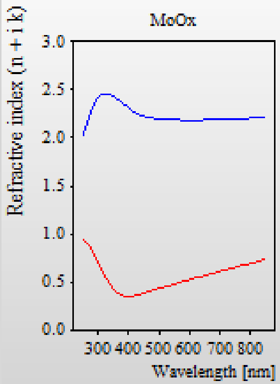
Analyze R and T spectra of single layer on glass
Get optical constants and thickness

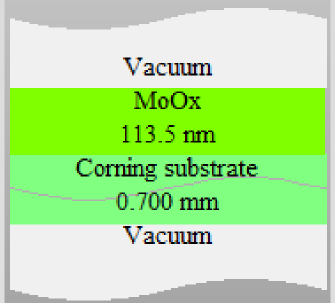
Loop through batch results

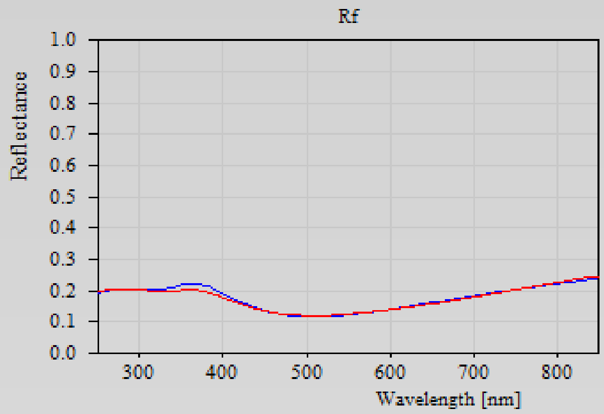
Sample: 6.5*10-4 mbar
Fit deviation: 0.0006677
Rating: Acceptable

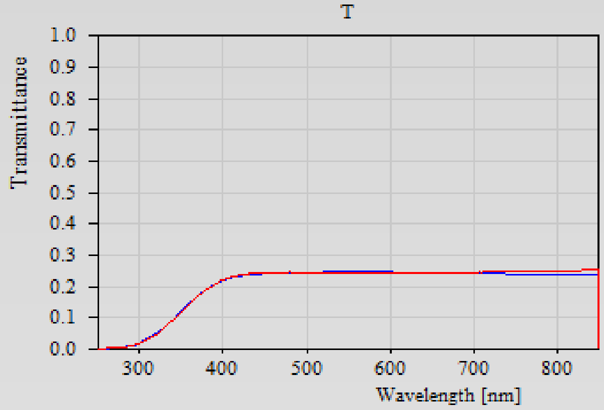
Fit parameters:

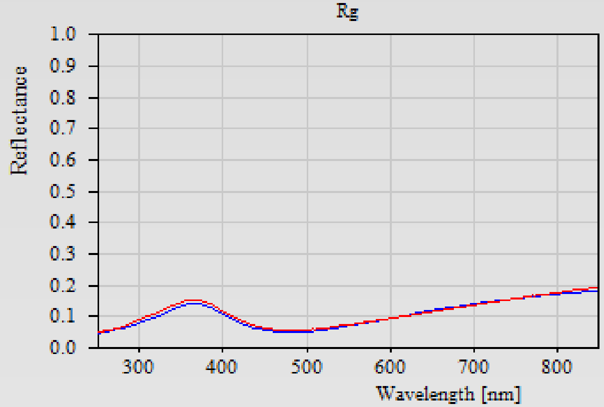
D	62067.5313	MoOx:Dr: plasma frequency
D	100000.0000	MoOx:Dr: damping
D	22894.7813	MoOx:K1: resonance frequency
D	4161.7715	MoOx:K1: oscillator strength
D	20000.0000	MoOx:K1: damping
D	2.0125	MoOx:OJL: Strength
D	24483.1367	MoOx:OJL: Gap energy
D	789.2793	MoOx:OJL: Gamma
D	15188.0488	MoOx:OJL: Decay
D	1.9361608	MoOx:n0
D	113.5	Stack 1 Layer 2 MoOx: Layer thickness











MoOx on Corning glass

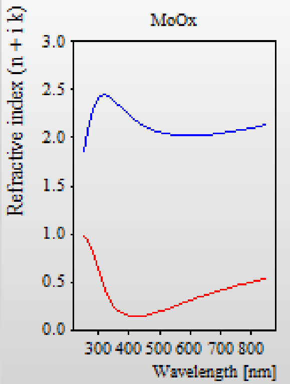
Analyze R and T spectra of single layer on glass
Get optical constants and thickness

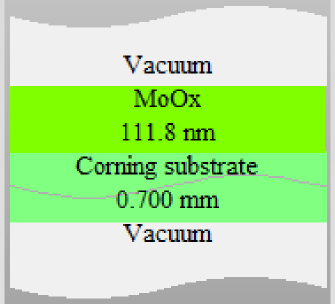
Loop through batch results

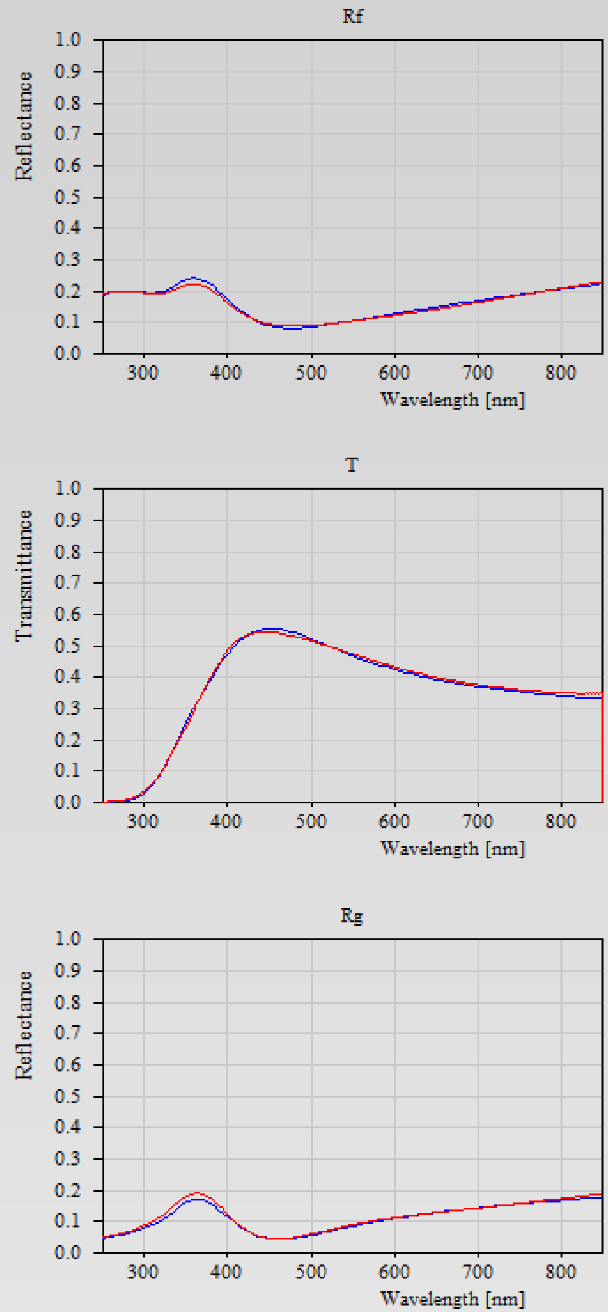
Sample: 7.5*10-4 mbar
Fit deviation: 0.0012493
Rating: Bad

Fit parameters:

D	0.0000	MoOx:Dr: plasma frequency	
D	69440.1875	MoOx:Dr: damping	
D	10000.0000	MoOx:K1: resonance frequency	
D	21077.5820	MoOx:K1: oscillator strength	
D	16150.4922	MoOx:K1: damping	
D	2.8509	MoOx:OJL: Strength	
D	27039.4473	MoOx:OJL: Gap energy	
D	2320.8511	MoOx:OJL: Gamma	
D	11359.4883	MoOx:OJL: Decay	
D	1.8977985	MoOx:n0	
D	111.8	Stack 1 Layer 2 MoOx: Layer thickness	







MoOx on Corning glass

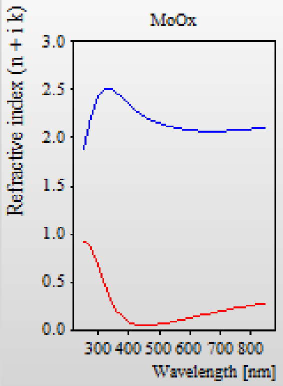
Analyze R and T spectra of single layer on glass
Get optical constants and thickness

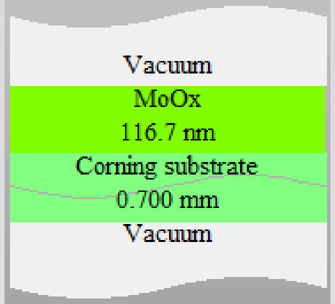
Loop through batch results

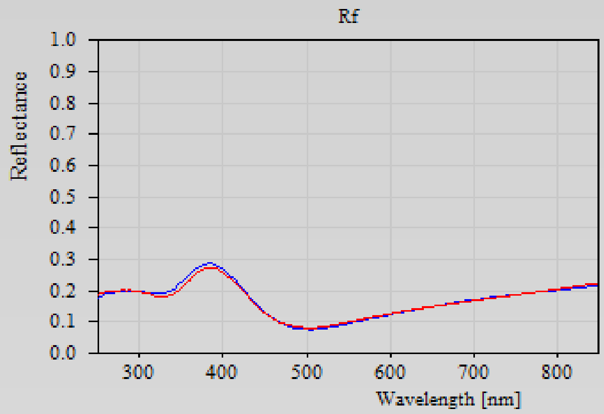
Sample: 8.5*10-4 mbar
Fit deviation: 0.0024896
Rating: Bad

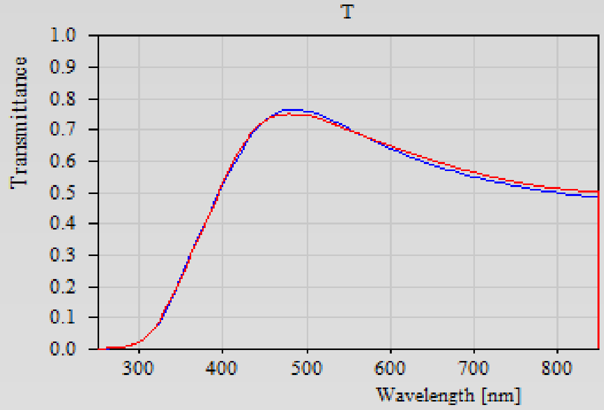
Fit parameters:

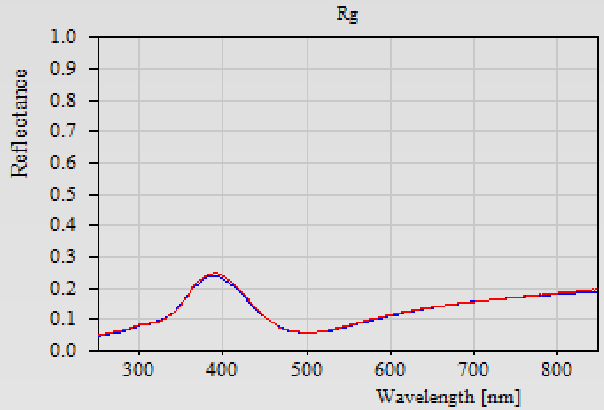
D	10307.2969	MoOx:Dr: plasma frequency	
D	100000.0000	MoOx:Dr: damping	
D	10000.0000	MoOx:K1: resonance frequency	
D	12726.0215	MoOx:K1: oscillator strength	
D	11961.5723	MoOx:K1: damping	
D	2.6563	MoOx:OJL: Strength	
D	24817.4238	MoOx:OJL: Gap energy	
D	1410.8596	MoOx:OJL: Gamma	
D	13363.9434	MoOx:OJL: Decay	
D	1.8794032	MoOx:n0	
D	116.7	Stack 1 Layer 2 MoOx: Layer thickness	





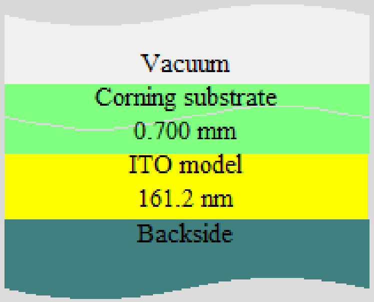


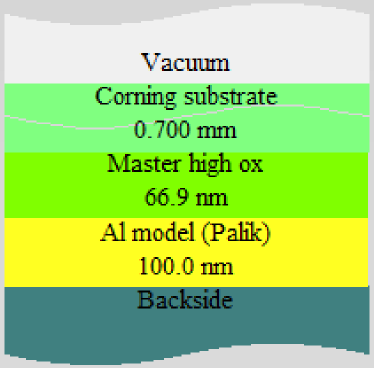


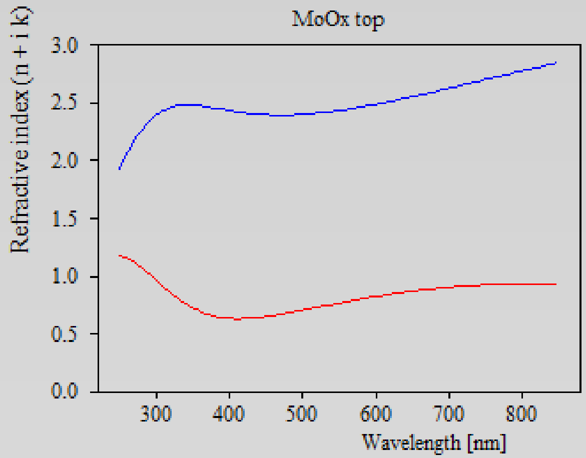


Design single layer AR coating

10		5.6449	Master high ox:Ox_flow
20		66.9	Stack 2 Layer 3 Master high ox: Layer thickness





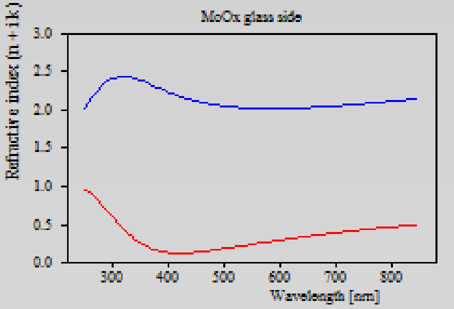


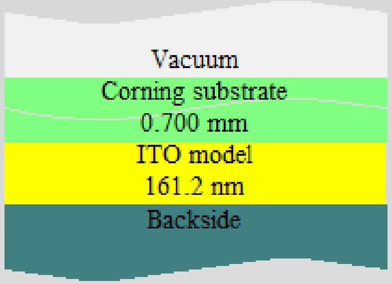
Dummy name

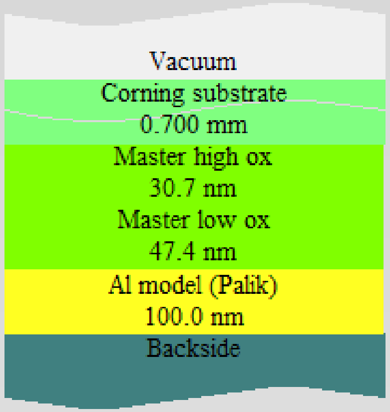
Integral quantity	**Current value**	**Target value**
Light reflectance (D65) (R ITO stack, Simulation)	0.0586	
a* / D65 / 2° (R ITO stack, Simulation)	0.7006	
b* / D65 / 2° (R ITO stack, Simulation)	-20.8307	
Light reflectance (D65) (R Al stack, Simulation)	0.0796	0.0586
a* / D65 / 2° (R Al stack, Simulation)	2.6150	0.7000
b* / D65 / 2° (R Al stack, Simulation)	-20.8725	-20.8000

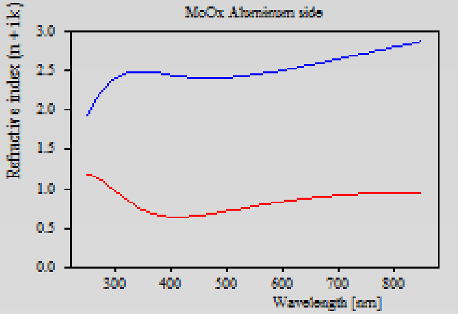
Design double layer AR coating

D		7.5001	Master high ox:Ox_flow	
D		30.7	Stack 2 Layer 3 Master high ox: Layer thickness	
D		5.6074	Master low ox:Ox_flow	
D		47.4	Stack 2 Layer 4 Master low ox: Layer thickness	









Dummy name

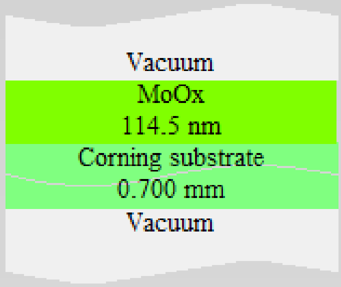
Integral quantity	**Current value**	**Target value**
Light reflectance (D65) (R ITO stack, Simulation)	0.0586	
a* / D65 / 2° (R ITO stack, Simulation)	0.7006	
b* / D65 / 2° (R ITO stack, Simulation)	-20.8307	
Light reflectance (D65) (R Al stack, Simulation)	0.0605	0.0586
a* / D65 / 2° (R Al stack, Simulation)	1.5932	0.7000
b* / D65 / 2° (R Al stack, Simulation)	-20.2361	-20.8000

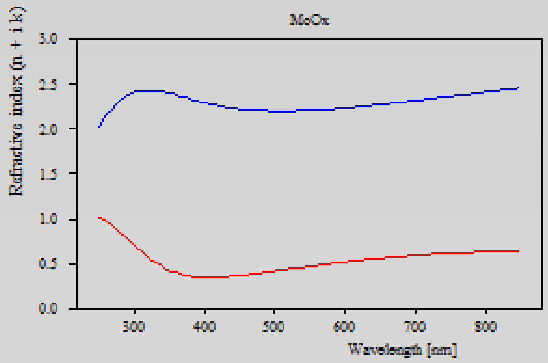
Production of MoOx layers:
Optical deposition control

- Measure T
- Get thickness and oxygen content

Integrate CODE through OLE automation

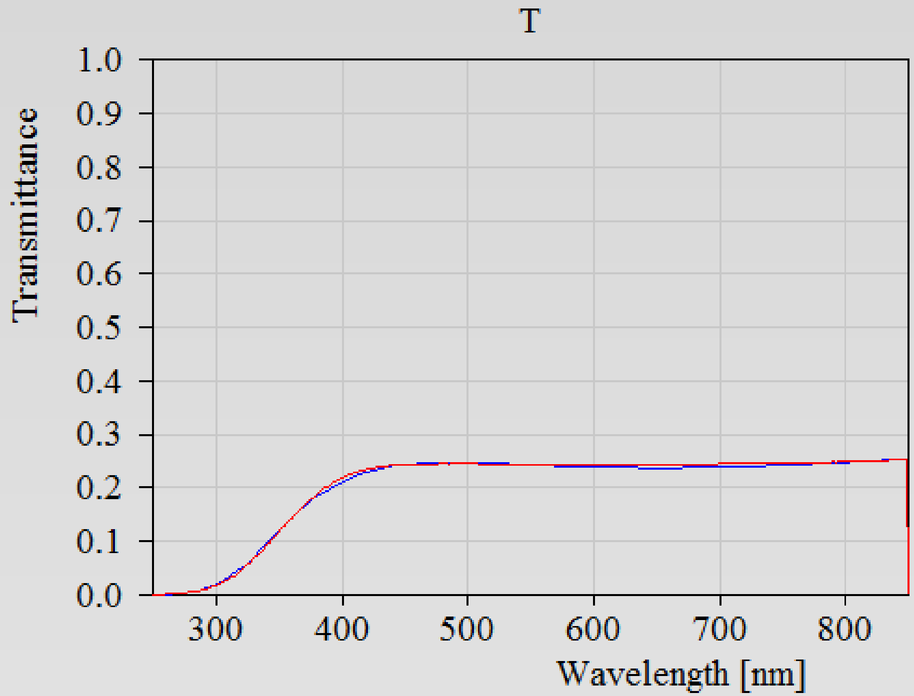
- Labview
- Data acquisition software
- Any modern programming language
- Excel





D	6.4867	MoOx:Ox_flow	
D	114.5	Stack 1 Layer 2 MoOx: Layer thickness	

Sample: 0815
Rating: 0.0007517
Fit deviation: Acceptable



CODE software generation 4

Easy, enhanced and elegant optical thin film analysis and design

W.Theiss Hard- and Software

Optical modeling for understanding thin film properties
Excellent modeling capabilities
Flexible graphical user interfaces

New in CODE 4:
- user guidance to solution templates
- tools to organize your work
- thin film solution network
- flexibility through scripts
- many small details improved