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Coating design contest: Antireflection coating for lenses to be used with normal and infrared photographic film

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Schott Glaswerke, 6500 Mainz 1, FRG

ABSTRACT

All contributed solutions to the coating design problem, sent out with the Advanced Program, are presented and evaluated.

2. THE PROBLEM

Task:
Design a multilayer antireflection to the specification given below. Two types of responses are solicited: Category A (conventional design): All layers are homogeneous and refractive indices correspond with the indices of the table; Category B (futuristic design): Mixtures of **oxide** materials (not with MgF_2) are permitted, both as homogeneous layers with inbetween refractive indices and/or tranition layers. The goal is lowest Figure of Merit F as defined under "Evaluation".

Specification:

Incidence medium index:	1.0 (air)
Incidence angle:	α=0°-30° (in air)
Substrate Index:	1.52
Maximum Reflectance:	$(R_{\alpha=0°})_{max} < 1\%$ and $((\frac{1}{2}R_s+\frac{1}{2}R_p)_{\alpha=30°})_{max} < 1\%$ λ = 400nm to 900nm
Polarization:	Unpolarized light
Thicknesses:	The physical thickness of all the layers together shall not exceed 2μ, the physical thickness of all the TiO_2-layers together shall not exceed 150nm.

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Coating materials:

Material	n at 400nm	n at 550nm	n at 900nm
MgF_2	1.39	1.38	1.37
SiO_2	1.47	1.46	1.45
Al_2O_3	1.65	1.63	1.60
Ta_2O_5	2.26	2.16	2.09
TiO_2	2.45	2.32	2.20

Index interpolations, both for dispersion and in-between indices, shall be linear. All coating materials are assumed free of losses.

Evaluation:

$$F = \left(\frac{1}{2(\lambda_2-\lambda_1)} \sum_{\lambda_1}^{\lambda_2} (R^2_{\alpha=0°} + \tfrac{1}{2}R^2_{s,\alpha=30°} + \tfrac{1}{2}R^2_{p,\alpha=30°})\, \Delta\lambda \right)^{\frac{1}{2}} \Rightarrow \min$$

$$\lambda_1 = 400\text{nm},\ \lambda_2 = 900\text{nm},\ \Delta\lambda = 1\text{nm}$$

Your solution shall contain:
Refractive indices at 550nm and physical thicknesses of all layers, reflectance plots, 400nm to 900nm, at α=0° and α=30° (in both planes of polarization), and method of interpolation for dispersion.

3. BACKGROUND OF THE PROBLEM

Optical coating design contests were carried out before[1,2].

The type of problem emerged during a meeting of the programm committee of the conference. It was formulated by the authors of this paper.

Wide band antireflection coatings are a great challenge to the optical coating designer. The question: "Over how wide a wavelength band can the reflectance be kept below a certain value" is unanswered. The design of antireflection coatings is further complicated by the fact that low reflectance is not only required at normal light incidence but also at oblique incidence.

The wavelength range from 400 to 900nm and the incidence angles of both 0° and 30° were dictated by the application. The lens designers would have preferred 45° but accepted 30°.

The substrate index of 1.52 was selected because it is easier to adapt an antireflection coating designed for a low substrate index to a high substrate index than the other way around. The lens designers would have preferred designs for substratre indices from 1.50 to 1.80 in .1 steps.

The limitation of the physical thickness of all TiO_2-layers together to 150nm was a compromise between taking advantage of a larger spread of refractive indices and minimizing the slight absorption TiO_2 has below 450nm.

Dispersion of the coating materials is an important element in the design of antireflection coatings because it decreases the bandwidth. A linear dispersion was selected for simplicity.

The coating materials selected are common when thermal evaporation is the method of deposition. In order to stimulate consideration other methods of deposition (sputtering, chemical vapor deposition), category B was allowed.

The definition of the Figure of Merit F (which, in this case of minimizing should have been called Defect Function) favored, because of its squared characteristic, smoother curves. The fact that 501 values were divided by 500 ($\lambda_2 - \lambda_1$) was a cosmetic defect. It did not affect the ranking, though.

4. EVALUATION

Each author of this paper wrote his own evaluation program and evaluated the contributions independent of the other. The results were compared. In case of discrepancies errors were corrected until complete agreement was reached.

A special feature of the evaluation was the treatment of inbetween refractive indices. They were treated as combinations of materials with neighboring refractive indices, interpolated linearly on the basis of the refractive indices. Materials with inbetween refractive indices above 2.16 would contribute to the total thickness of all TiO_2-layers as a consequence.

The Figures of Merit given by the contributors often disagreed with the Figures of Merit calculated by the authors. There were several reasons: 1. early versions of the specification used a substrate index of 1.50 rather than 1.52, 2. there was a misprint in the definition of the Figure of Merit in the Advanced Program, 3. the reflectances at angle were first added and then

squared rather than adding the squares, 4. dispersion was added into the substrate index, 5. the reflectances were taken in steps different from 1nm, and 6. non-linear interpolation of the refractive indices was used.

5. CONTRIBUTIONS

There were 44 designs contributed by 28 authors. 41 designs were in category A and 3 in category B. All contributions are presented in the same format on the subsequent pages.

6. AWARDS

Only contributions which met all parts of the specification were eligible for awards. In category A the three lowest Figures of Merit were reached by

1st Prize: **W.H. Southwell**, $F = 2.721 \times 10^{-3}$

2nd Prize: **anonymous**, $F = 3.202 \times 10^{-3}$

3rd Prize: **H.R. Dobler**, $F = 3.215 \times 10^{-3}$

In category B the lowest Figure of Merit was reached by

1st Prize: **R.H. Miller**, $F = 3.172 \times 10^{-3}$

We also decided to give special awards.

Lowest-Total-Thickness Prize: **J.E. Simpson**, 346.5nm

Lowest-Number-of-Layers Prize: **V.A. Trevino**, 7 layers

Surprise Award: **H. Greiner**, all thicknesses are multiples of 10nm.

7. STARTING DESIGNS

Most designers did not reveal their starting designs. The authors feel that this should be a condition of participation in future contests of this type. Some did:

1. Anonymous, M. Friz, and H.R. Dobler used starting designs of the type $(HL)^q$, as proposed by Baumeister[3]
2. E. Hacker used Chebyshev Polynomials

3. J. Hrdina and most likely W.H. Southwell used flip-flop methods[4,5]
4. H.A. Macleod used classical design methods (absentee layers, buffer layers, and admittance diagrams. His paper is scheduled to be included in these proceedings as a poster paper.

9. CONCLUSIONS

Fig.1 gives a plot of the Figure of Merit F as a function of the total physical thickness for each design. Designs which include refractive indices higher than 2.16 are shown as black dots, the ones without as grey dots. Two lines connect the lowest Figures of Merit of the designs with TiO_2 and one line the lowest Figures of Merit of the designs without TiO_2.

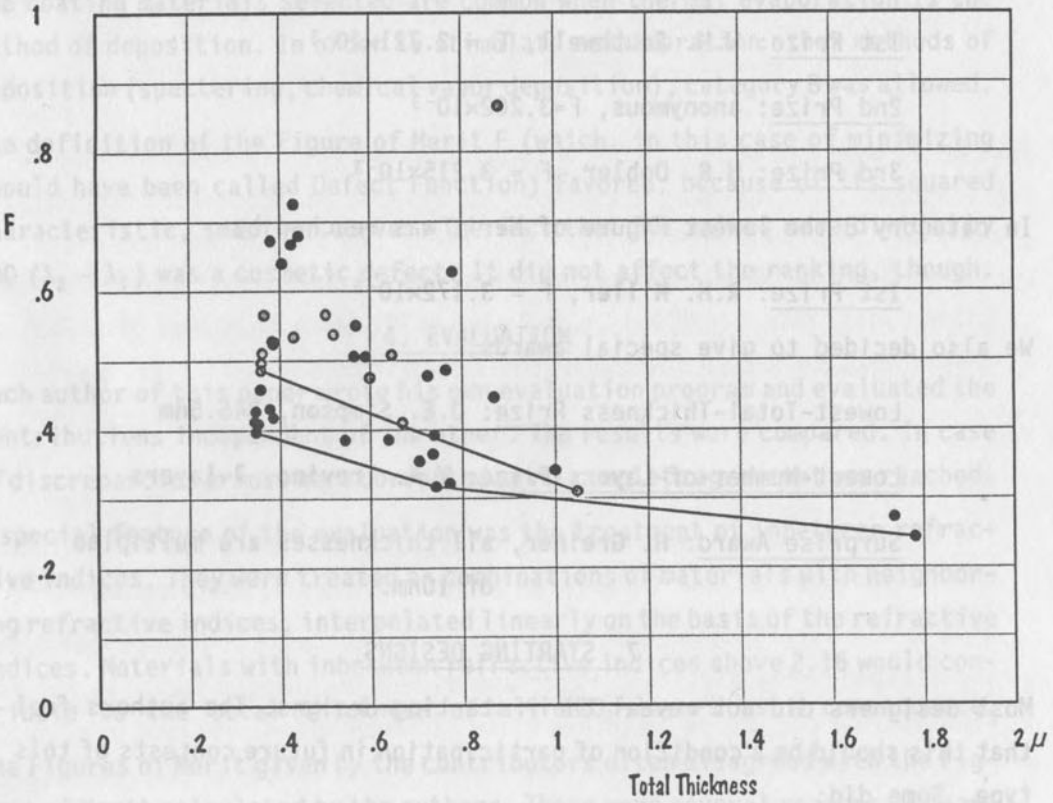

Fig.1 Figure of Merit as a function of total physical thickness, black circles with TiO_2 and grey circles without TiO_2

We can draw the following conclusions:

1. Increasing the total physical thickness improves the performance only mildly. Quintuplicating the thickness reduces the Figure of Merit by one third.
2. The wider the refractive index spread the better the potential performance.
3. At approximately the same total physical thickness, the Figures of Merit varied by a factor of two. The position within this spread is most likely a combination of skill, intuition, and luck of the designer.

In the short time available, the authors could not come up with additional structures of the data. It is hoped that, after the data sink in, additional insights will emerge.

10. ACKNOWLEDGEMENTS

Most of the work presented here is that of the contributors. It is they and their institutions who deserve the most credit.

11. REFERENCES

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3. P. Baumeister (1992), Detailed knowledge of optical design techniques may be superfluous to produce usable coatings, Fifth Topical Meeting on Optical Interference coatings of the Optical Society of America, Loews Ventana Canyon Resort, Tucson, Arizona, June 1-5, 1992, paper OMB1-1.
4. W.H. Southwell (1985), Coating Design using very thin high- and low index layers, Applied Optics 24, pp. 457-460
5. J. Hrdina (1989), A technologically acceptable coating synthesis based on the flip-flop synthesis method, J. Mod. Optics 36, pp.111-118

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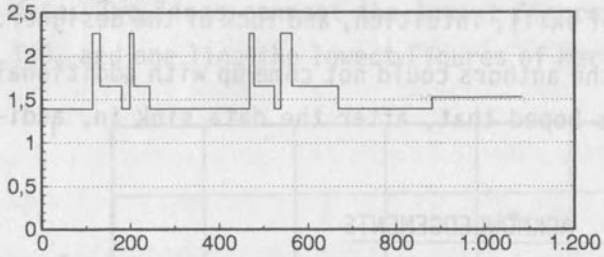
ISRO Satellite Centre
A 5-6 Peenya Ind. Estate
Bangalore 560 058, India

Design category A:

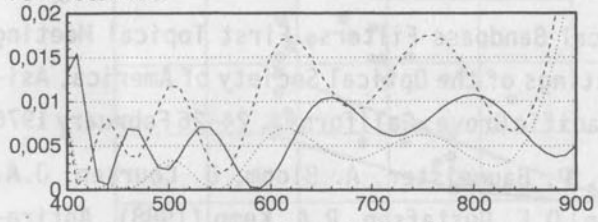
#	nm	material
1	114,5	MgF2
2	17,5	Ta2O5
3	49	Al2O3
4	17,5	MgF2
5	10	Ta2O5
6	35	Al2O3
7	224	MgF2
8	11,5	Ta2O5
9	45	Al2O3
10	15	MgF2
11	25	Ta2O5
12	105	Al2O3
13	212,5	MgF2

refr. index



Result:

reflectance



# of layers: 13
# of materials: 3

Ⓧ	total thickness (<= 2000 nm):	881.5 nm
Ⓧ	thickness of TiO2-layers (<=150 nm):	0 nm
○	Max Ro (< 1%):	1.62 %
○	Max (Rs + Rp)/2 (< 1%):	3.18 %

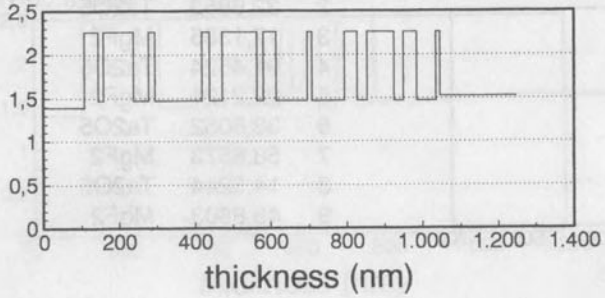
Meritfunction: $8.651 * 10^{-3}$

ISRO1.DRW

Author: anonymous

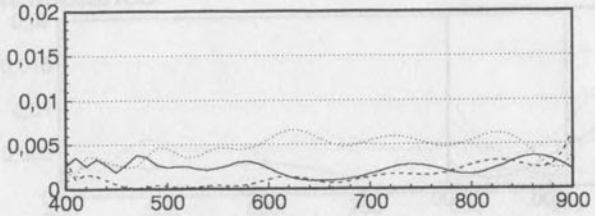
Design category A:

refr. index



Result:

reflectance



#	nm	material
1	108,1	MgF2
2	37,2	Ta2O5
3	12,4	SiO2
4	80,5	Ta2O5
5	40,2	SiO2
6	16,2	Ta2O5
7	124,5	SiO2
8	19,4	Ta2O5
9	34,2	SiO2
10	91,3	Ta2O5
11	17,1	SiO2
12	34,1	Ta2O5
13	80,6	SiO2
14	11,6	Ta2O5
15	86,6	SiO2
16	33,1	Ta2O5
17	26,9	SiO2
18	70,6	Ta2O5
19	23,8	SiO2
20	35,9	Ta2O5
21	50,2	SiO2
22	11,5	Ta2O5

# of layers: 22
# of materials: 3
⊗ total thickness (<= 2000 nm): 1046.0 nm
⊗ thickness of TiO2-layers (<= 150 nm): 0 nm
⊗ Max Ro (< 1%): 0.39 %
⊗ Max (Rs + Rp)/2 (< 1%): 0.51 %

Meritfunction: $3.101 * 10^{-3}$

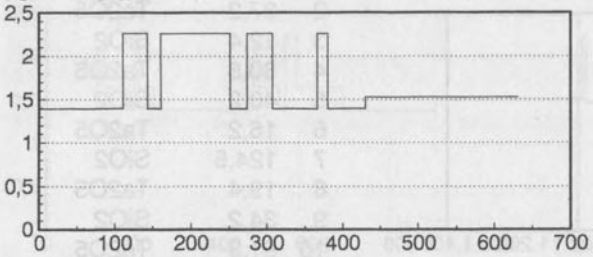
ANON1.DRW

Author: L. Dick
Docter Optische Werke
Perfektastr. 89
A 1235 Wien, Austria

Design category A:

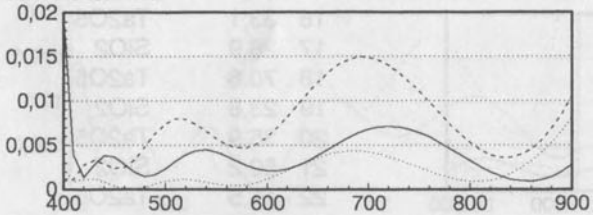
#	nm	material
1	110,3712	MgF2
2	32,6853	Ta2O5
3	17,1385	MgF2
4	91,4524	Ta2O5
5	22,2121	MgF2
6	33,6052	Ta2O5
7	58,6573	MgF2
8	14,3244	Ta2O5
9	49,8803	MgF2

refr. index



Result:

reflectance



# of layers: 9
# of materials: 2
Ⓧ total thickness (<= 2000 nm): 430.3 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 0 nm
○ Max Ro (< 1%): 1.97 %
Ⓧ Max (Rs + Rp)/2 (< 1%): 0.96 %

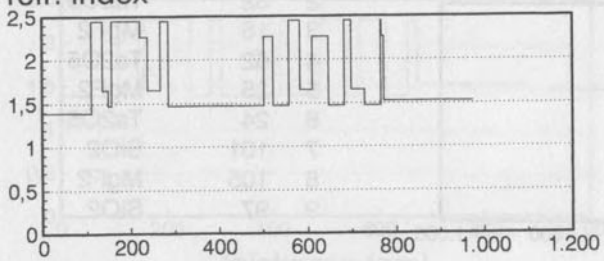
Meritfunction: $5.341 * 10^{-3}$

DOCT1.DRW

Author: H.R. Dobler
Carl Zeiss
Oberkochen, Germany

Design category A:

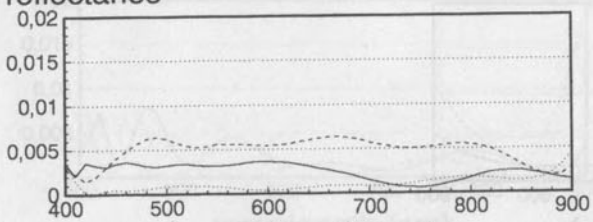
refr. index



#	nm	material
1	111	MgF2
2	25,5	TiO2
3	11,89	Al2O3
4	9	SiO2
5	63,6	TiO2
6	17,2	Ta2O5
7	28,5	Al2O3
8	18,1	TiO2
9	216,7	SiO2
10	21,83	Ta2O5
11	34,72	SiO2
12	25	TiO2
13	27,19	Al2O3
14	37,86	Ta2O5
15	35	SiO2
16	15,5	TiO2
17	30,68	Al2O3
18	36,37	SiO2
19	2,3	TiO2
20	4,77	Ta2O5

Result:

reflectance



# of layers: 20
# of materials: 5
⊗ total thickness (<= 2000 nm): 772.7 nm
⊗ thickness of TiO2-layers (<= 150 nm): 150.0 nm
⊗ Max Ro (< 1%): 0.36 %
⊗ Max (Rs + Rp)/2 (< 1%): 0.36 %

Meritfunction: $3.215 * 10^{-3}$

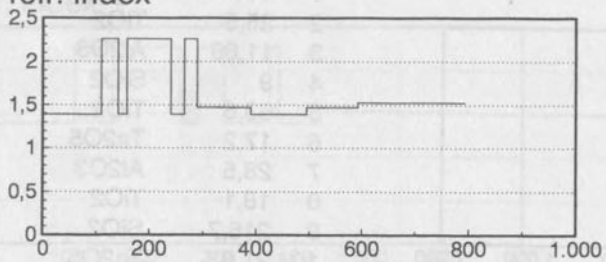
DOBL1.DRW

Author: G. Emiliani
ENEA Thin Film Laboratory
Via Anguillarese 301
00060 Roma, Italy

Design category A:

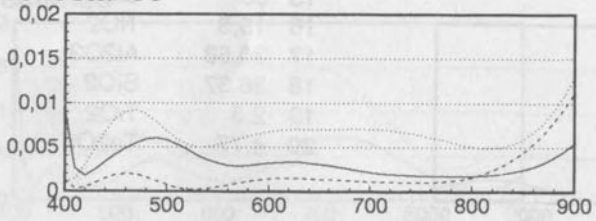
#	nm	material
1	110	MgF2
2	32	Ta2O5
3	16	MgF2
4	82	Ta2O5
5	25	MgF2
6	24	Ta2O5
7	101	SiO2
8	105	MgF2
9	97	SiO2

refr. index



Result:

reflectance



	# of layers:	9
	# of materials:	3
⊗	total thickness (<= 2000 nm):	592 nm
⊗	thickness of TiO2-layers (<= 150 nm):	0 nm
⊗	Max Ro (< 1%):	0.92 %
○	Max (Rs + Rp)/2 (< 1%):	1.20 %

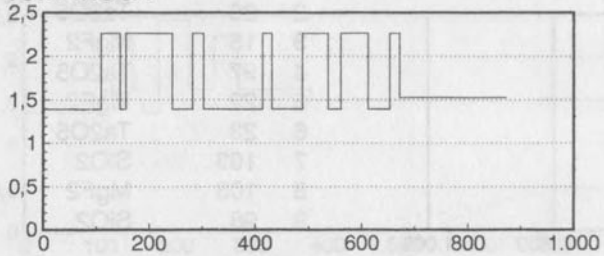
Meritfunction: $4.378 * 10^{-3}$

ENEA1.DRW

Author: G. Emiliani
ENEA Thin Film Laboratory
Via Anguillarese 301
00060 Roma, Italy

Design category A:

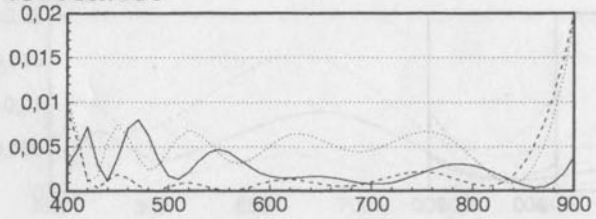
refr. index



#	nm	material
1	109	MgF2
2	36	Ta2O5
3	11	MgF2
4	87	Ta2O5
5	39	MgF2
6	21	Ta2O5
7	111	MgF2
8	17	Ta2O5
9	57	MgF2
10	48	Ta2O5
11	25	MgF2
12	51	Ta2O5
13	40	MgF2
14	19	Ta2O5

Result:

reflectance



# of layers: 14
# of materials: 2
Ⓧ total thickness (<= 2000 nm): 671.0 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 0 nm
Ⓧ Max Ro (< 1%): 0.80 %
○ Max (Rs + Rp)/2 (< 1%): 1.96 %

Meritfunction: $4.102 * 10^{-3}$

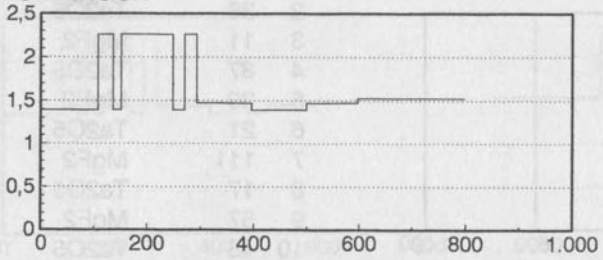
ENEA2.DRW

Author: G. Emiliani
ENEA Thin Film Laboratory
Via Anguillarese 301
00060 Roma, Italy

Design category A:

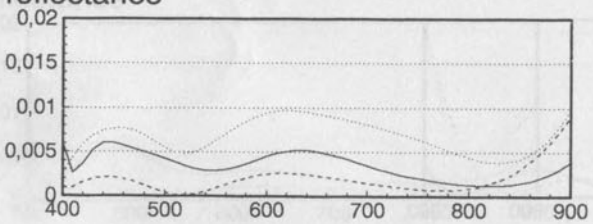
#	nm	material
1	108	MgF2
2	28	Ta2O5
3	15	MgF2
4	97	Ta2O5
5	22	MgF2
6	23	Ta2O5
7	103	SiO2
8	103	MgF2
9	98	SiO2

refr. index



Result:

reflectance



# of layers: 9
# of materials: 3
Ⓧ total thickness (<= 2000 nm): 597.0 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 0 nm
Ⓧ Max Ro (< 1%): 0.61 %
Ⓧ Max (Rs + Rp)/2 (< 1%): 0.94 %

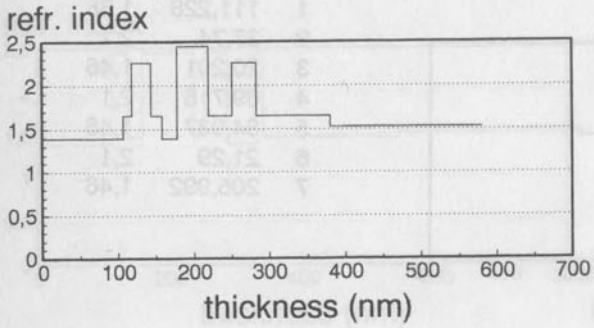
Meritfunction: $4.549 * 10^{-3}$

ENEA3.DRW

Author: L. Eriksson
BPT Optik AB
Träffgatan 2
S-13644 Haninge , Sweden

Design category A:

#	nm	material
1	107,08	MgF2
2	11,15	Al2O3
3	25,5	Ta2O5
4	14,56	Al2O3
5	19,78	MgF2
6	41,62	TiO2
7	31,13	Al2O3
8	31,71	Ta2O5
9	97,65	Al2O3



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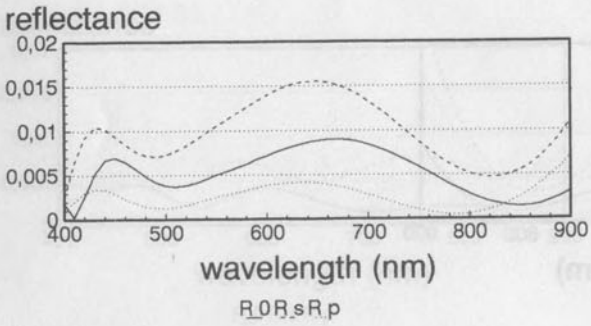


# of layers:	9
# of materials:	4
⊗ total thickness (<= 2000 nm):	380.2 nm
⊗ thickness of TiO2-layers (<= 150 nm):	41.6 nm
⊗ Max Ro (< 1%):	0.89 %
⊗ Max (Rs + Rp)/2 (< 1%):	0.98 %

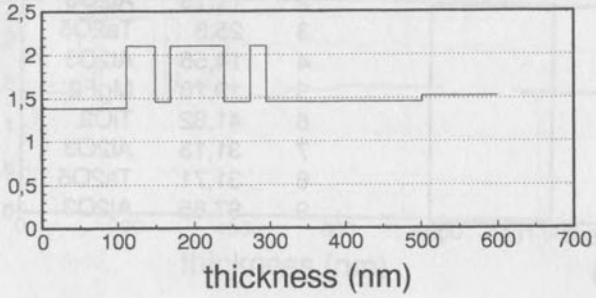
Meritfunction: $6.727 * 10^{-3}$

ERIK1.DRW

Author: M. Friz
Merck
Frankfurter Str. 250
6100 Darmstadt, Germany

Design category B:

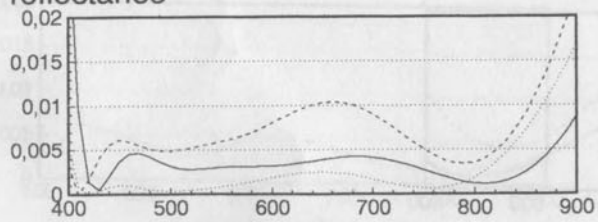
refr. index



#	nm	material
1	111,228	1,38
2	37,74	2,1
3	20,201	1,46
4	69,716	2,1
5	34,937	1,46
6	21,29	2,1
7	205,992	1,46

Result:

reflectance



# of layers: 13
# of materials: 3
Ⓧ total thickness (<= 2000 nm): 501.1 nm
Ⓧ thickness of TiO2-layers (<=150 nm): 0 nm
◯ Max Ro (< 1%): 3.17 %
◯ Max (Rs + Rp)/2 (< 1%): 1.99 %

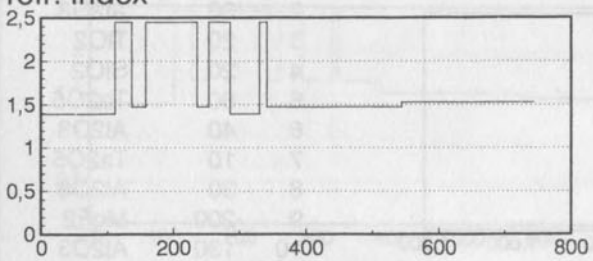
Meritfunction: $5.654 * 10^{-3}$

MERC1.DRW

Author: P. Ganner
Swarovski & Co
A 6112 Wattens, Austria

Design category A:

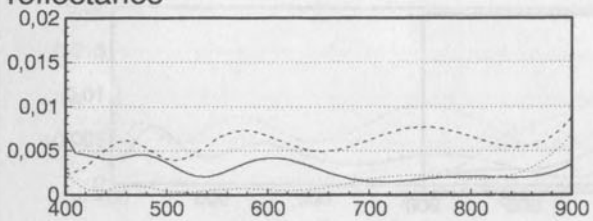
refr. index



#	nm	material
1	111,27	MgF2
2	25,87	TiO2
3	20,37	SiO2
4	78,43	TiO2
5	16,97	SiO2
6	32,59	TiO2
7	44,4	MgF2
8	11,8	TiO2
9	201,89	SiO2

Result:

reflectance



# of layers: 9
# of materials: 3
⊗ total thickness (<= 2000 nm): 543.6 nm
⊗ thickness of TiO2-layers (<= 150 nm): 148.7 nm
⊗ Max Ro (< 1%): 0.68 %
⊗ Max (Rs + Rp)/2 (< 1%): 0.78 %

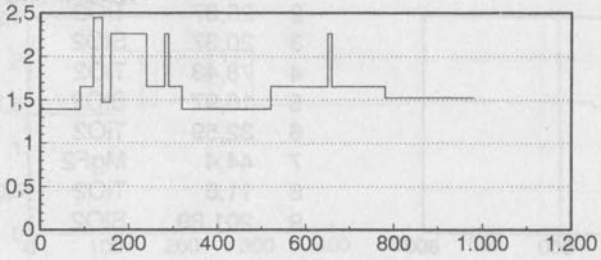
Meritfunction: $3.854 * 10^{-3}$

SWAR1.DRW

Author: H. Greiner
Philips Research Laboratories
Aachen, Germany

Design category A:

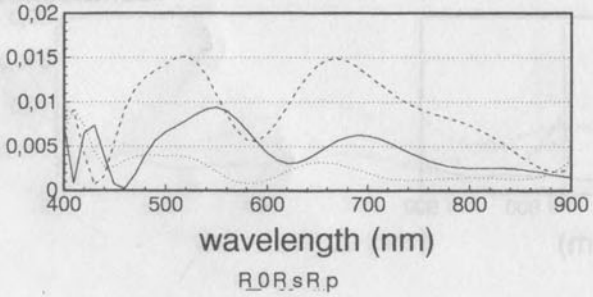
refr. index



#	nm	material
1	90	MgF2
2	30	Al2O3
3	20	TiO2
4	20	SiO2
5	80	Ta2O5
6	40	Al2O3
7	10	Ta2O5
8	30	Al2O3
9	200	MgF2
10	130	Al2O3
11	10	Ta2O5
12	120	Al2O3

Result:

reflectance



# of layers: 12
# of materials: 5
Ⓧ total thickness (<= 2000 nm): 780.0 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 20.0 nm
Ⓧ Max Ro (< 1%): 0.94 %
Ⓧ Max (Rs + Rp)/2 (< 1%): 0.95 %

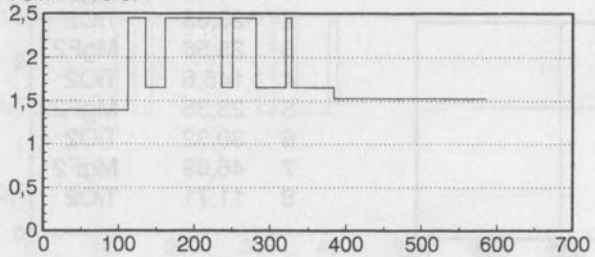
Meritfunction: $6.273 * 10^{-3}$

PHIL1.DRW

Author: K. Gürtler
Jos. Schneider Optische Werke
Ringstr. 132
6550 Bad Kreuznach, FRG

Design category A:

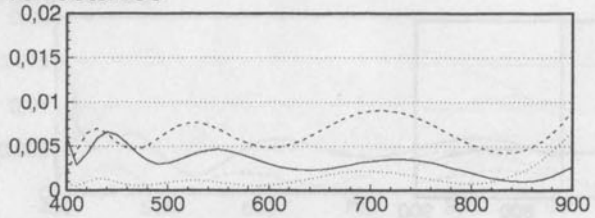
refr. index



#	nm	material
1	112,31	MgF2
2	22,55	TiO2
3	26,31	Al2O3
4	75,4	TiO2
5	13,95	Al2O3
6	31,17	TiO2
7	38,95	Al2O3
8	7,11	TiO2
9	56,65	Al2O3

Result:

reflectance



# of layers: 9
# of materials: 3
Ⓧ total thickness (<= 2000 nm): 384.2 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 136.2 nm
Ⓧ Max Ro (< 1%): 0.67 %
Ⓧ Max (Rs + Rp)/2 (< 1%): 0.79 %

Meritfunction: $4.179 * 10^{-3}$

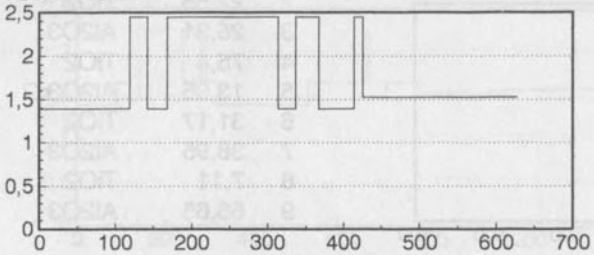
SCHN1.DRW

Author: E. Hacker
Jenoptik Dünnschichtzentrum
Carl Zeiss Str. 1
O-6900 Jena, FRG

Design category A:

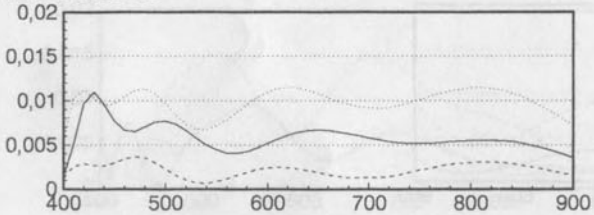
#	nm	material
1	119,2	MgF2
2	23,03	TiO2
3	25,56	MgF2
4	145,6	TiO2
5	23,36	MgF2
6	30,32	TiO2
7	46,69	MgF2
8	11,71	TiO2

refr. index



Result:

reflectance



	# of layers:	8
	# of materials:	2
⊗	total thickness (<= 2000 nm):	425.5 nm
○	thickness of TiO2-layers (<= 150 nm):	210.7 nm
○	Max Ro (< 1%):	1.10 %
⊗	Max (Rs + Rp)/2 (< 1%):	0.75 %

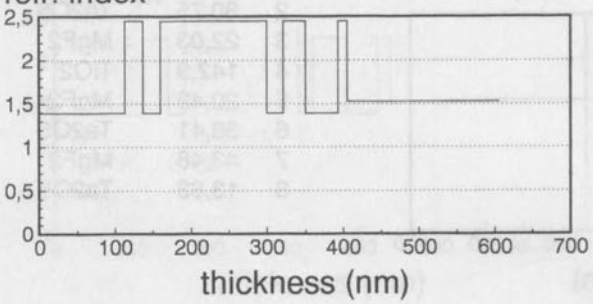
Meritfunction: $6.675 * 10^{-3}$

HACK1.DRW

Author: E. Hacker
Jenoptik Dünnschichtzentrum
Carl Zeiss Str. 1
O-6900 Jena, FRG

Design category A:

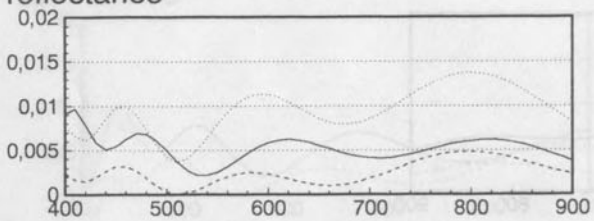
refr. index



#	nm	material
1	113,2	MgF2
2	23,26	TiO2
3	23,39	MgF2
4	140,2	TiO2
5	21,07	MgF2
6	29,58	TiO2
7	42,5	MgF2
8	11,83	TiO2

Result:

reflectance



# of layers: 8
# of materials: 3
Ⓧ total thickness (<= 2000 nm): 405.0 nm
○ thickness of TiO2-layers (<= 150 nm): 204.9 nm
Ⓧ Max Ro (< 1%): 0.98 %
Ⓧ Max (Rs + Rp)/2 (< 1%): 0.93 %

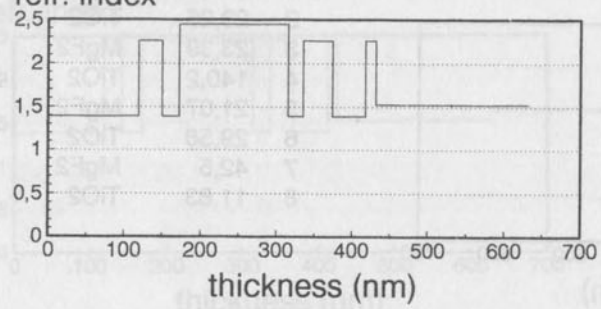
Meritfunction: $6.401 * 10^{-3}$

HACK2.DRW

Author: E. Hacker
Jenoptik Dünnschichtzentrum
Carl Zeiss Str. 1
O-6900 Jena, FRG

Design category A:

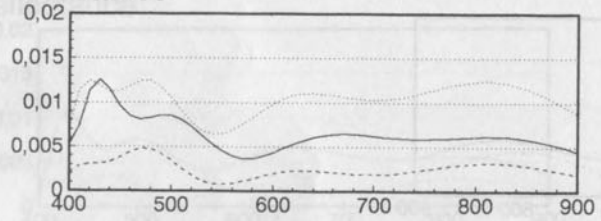
refr. index



#	nm	material
1	119	MgF2
2	30,75	Ta2O5
3	22,03	MgF2
4	142,9	TiO2
5	20,49	MgF2
6	38,41	Ta2O5
7	43,46	MgF2
8	13,83	Ta2O5

Result:

reflectance



# of layers: 8
# of materials: 3
Ⓧ total thickness (<= 2000 nm): 430.9 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 142.9 nm
○ Max Ro (< 1%): 1.26 %
Ⓧ Max (Rs + Rp)/2 (< 1%): 0.87 %

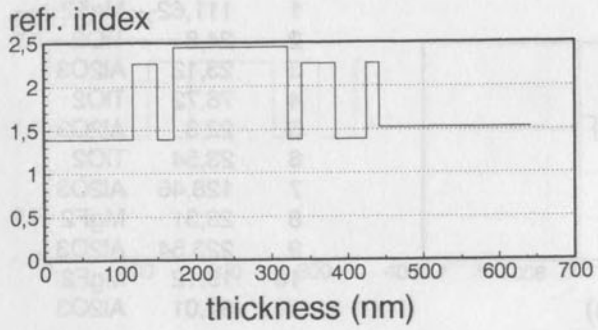
Meritfunction: $7.250 * 10^{-3}$

HACK3.DRW

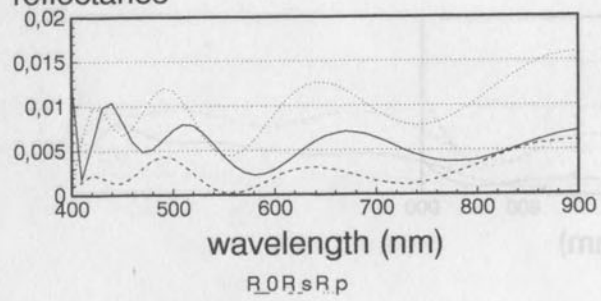
Author: E. Hacker
Jenoptik Dünnschichtzentrum
Carl Zeiss Str. 1
O-6900 Jena, FRG

Design category A:

#	nm	material
1	117,6	MgF2
2	32,31	Ta2O5
3	21,35	MgF2
4	150,2	TiO2
5	18,36	MgF2
6	43,74	Ta2O5
7	41,12	MgF2
8	16,91	Ta2O5



Result:



	# of layers:	8
	# of materials:	3
⊗	total thickness (<= 2000 nm):	441.6 nm
○	thickness of TiO2-layers (<= 150 nm):	150.2 nm
○	Max Ro (< 1%):	1.27 %
○	Max (Rs + Rp)/2 (< 1%):	1.09 %

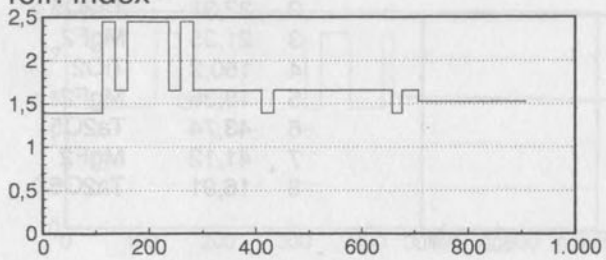
Meritfunction: $6.794 * 10^{-3}$

HACK4.DRW

Author: J. Hrdina
Institute of Physics
Na Slovance 2
18040 Prague 8, Czechosloakia

Design category A:

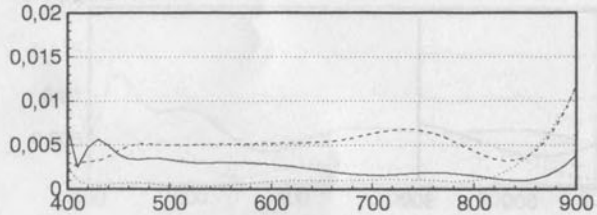
refr. index



#	nm	material
1	111,62	MgF2
2	24,8	TiO2
3	23,12	Al2O3
4	76,72	TiO2
5	22,3	Al2O3
6	23,54	TiO2
7	128,46	Al2O3
8	23,31	MgF2
9	223,54	Al2O3
10	19,12	MgF2
11	31,01	Al2O3

Result:

reflectance



# of layers: 11
# of materials: 3
Ⓧ total thickness (<= 2000 nm): 707.5 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 125.1 nm
Ⓧ Max Ro (< 1%): 0.69 %
◯ Max (Rs + Rp)/2 (< 1%): 1.16 %

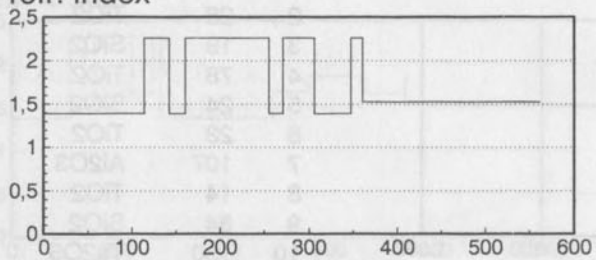
Meritfunction: $3.544 * 10^{-3}$

HRDI1.DRW

Author: A. McLeod
The University of Arizona
Tucson, Arizona 85721, US

Design category A:

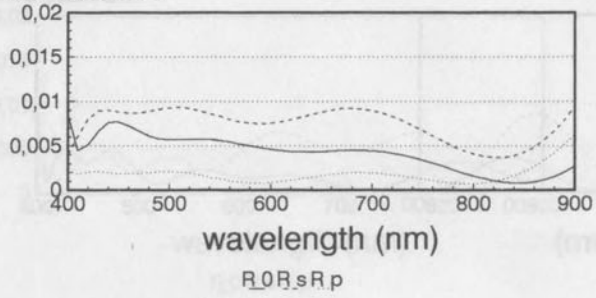
refr. index



#	nm	material
1	113,82	MgF2
2	28,17	Ta2O5
3	18,52	MgF2
4	94,21	Ta2O5
5	15,78	MgF2
6	35,85	Ta2O5
7	41,29	MgF2
8	13,1	Ta2O5

Result:

reflectance



# of layers: 8
# of materials: 2
Ⓧ total thickness (<= 2000 nm): 360.7 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 0 nm
Ⓧ Max Ro (< 1%): 0.84 %
Ⓧ Max (Rs + Rp)/2 (< 1%): 0.78 %

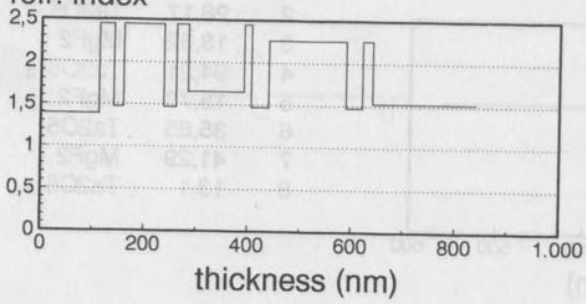
Meritfunction: $5.107 * 10^{-3}$

MCLE1.DRW

Author: R.H. Miller
Optical Physicist
1816 Arroyo Sierra Court
Santa Rosa, CA 95405, US

Design category A:

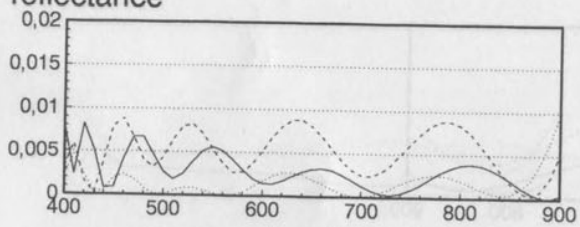
refr. index



#	nm	material
1	112	MgF2
2	28	TiO2
3	19	SiO2
4	78	TiO2
5	24	SiO2
6	23	TiO2
7	107	Al2O3
8	14	TiO2
9	34	SiO2
10	150	Ta2O5
11	32	SiO2
12	19	Ta2O5

Result:

reflectance



# of layers: 12
# of materials: 5

⊗	total thickness (<= 2000 nm):	640.0 nm
⊗	thickness of TiO2-layers (<= 150 nm):	143.0 nm
⊗	Max Ro (< 1%):	0.82 %
⊗	Max (Rs + Rp)/2 (< 1%):	0.75 %

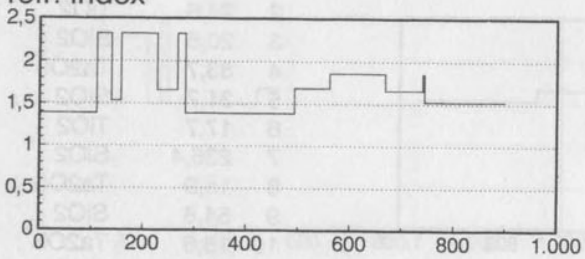
Meritfunction: $3.860 * 10^{-3}$

MILL1.DRW

Author: R.H. Miller
Optical Physicist
1816 Arroyo Sierra Court
Santa Rosa, CA 95405, US

Design category B:

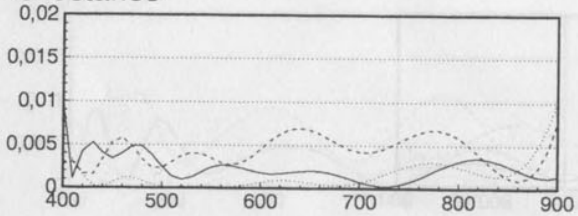
refr. index



#	nm	material
1	110	1,38
2	28,88	2,32
3	17,67	1,5291
4	70,1	2,32
5	39,38	1,6545
6	15,7	2,32
7	210,78	1,38
8	67,96	1,6881
9	107,03	1,8591
10	72,82	1,6596
11	2,7	1,8549

Result:

reflectance



# of layers: 11
# of materials:
Ⓧ total thickness (<= 2000 nm): 743.0 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 114.7 nm
Ⓧ Max Ro (< 1%): 0.97 %
Ⓧ Max (Rs + Rp)/2 (< 1%): 0.89 %

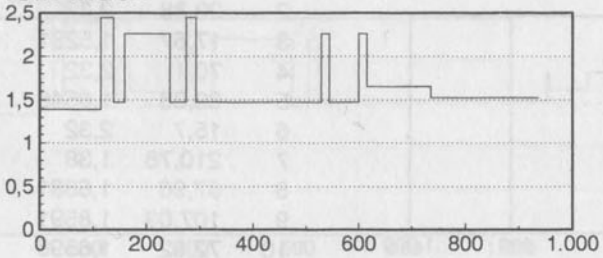
Meritfunction: $3.172 * 10^{-3}$

MILL2.DRW

Author: J. Mouchart
Laserdot
Route de Nozay
91460 Marcoussis, France

Design category A:

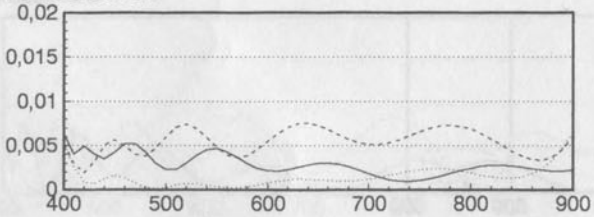
refr. index



#	nm	material
1	114	MgF2
2	24,6	TiO2
3	20,6	SiO2
4	83,7	Ta2O5
5	31,7	SiO2
6	17,7	TiO2
7	236,4	SiO2
8	15,9	Ta2O5
9	54,8	SiO2
10	15,6	Ta2O5
11	121,2	Al2O3

Result:

reflectance



# of layers: 11
# of materials: 5
Ⓧ total thickness (<= 2000 nm): 736.2 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 42.3 nm
Ⓧ Max Ro (< 1%): 0.64 %
Ⓧ Max (Rs + Rp)/2 (< 1%): 0.63 %

Meritfunction: $3.645 * 10^{-3}$

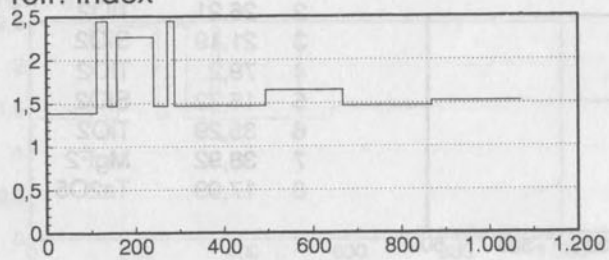
LASE1.DRW

Author: J. Mouchart
Laserdot
Route de Nozay
91460 Marcoussis, France

Design category A:

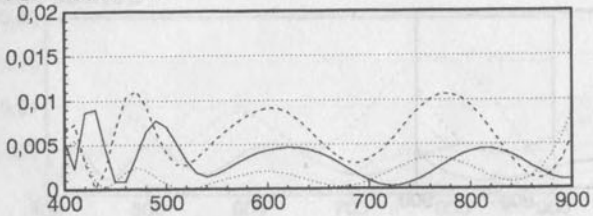
#	nm	material
1	112,8	MgF2
2	24,5	TiO2
3	20,5	SiO2
4	82,3	Ta2O5
5	31,8	SiO2
6	16,8	TiO2
7	205,5	SiO2
8	172,6	Al2O3
9	202	SiO2

refr. index



Result:

reflectance



# of layers: 9
# of materials: 5
⊗ total thickness (<= 2000 nm): 868.8 nm
⊗ thickness of TiO2-layers (<= 150 nm): 41.3 nm
⊗ Max Ro (< 1%): 0.98 %
⊗ Max (Rs + Rp)/2 (< 1%): 0.72 %

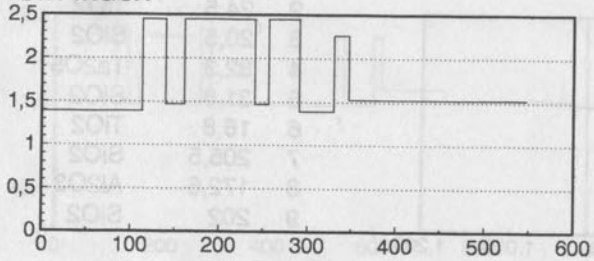
Meritfunction: $4.465 * 10^{-3}$

LASE2.DRW

Author: T. Noe
Software Spectra Inc
14025 N.W. Harvest Lane
Portland, OR 97229-3645, US

Design category A:

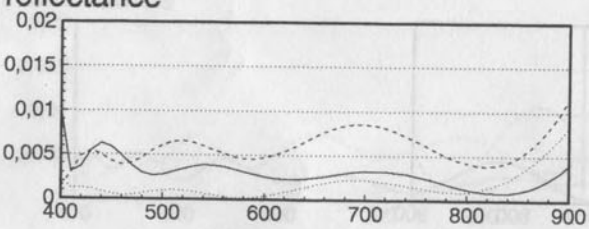
refr. index



#	nm	material
1	113,12	MgF2
2	26,21	TiO2
3	21,19	SiO2
4	79,2	TiO2
5	15,72	SiO2
6	35,29	TiO2
7	38,92	MgF2
8	17,09	Ta2O5

Result:

reflectance



# of layers: 8
# of materials: 4
⊗ total thickness (<= 2000 nm): 346.7 nm
⊗ thickness of TiO2-layers (<= 150 nm): 140.7 nm
⊗ Max Ro (< 1%): 0.99 %
⊗ Max (Rs + Rp)/2 (< 1%): 0.99 %

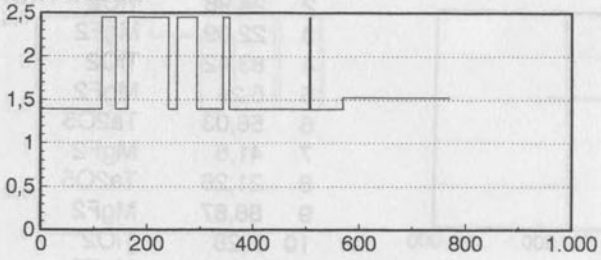
Meritfunction: $3.969 * 10^{-3}$

SSI_1.DRW

Author: M. L. Rastello
Instituto Elettrotecnico Nazionale
Strada delle Cacce 91
I 10135 Torino, Italy

Design category A:

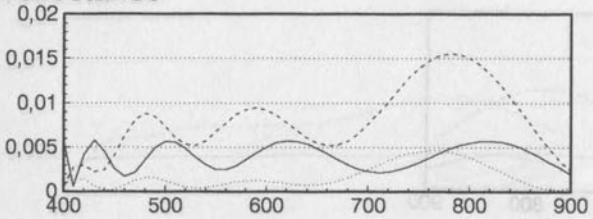
refr. index



#	nm	material
1	114,31	MgF2
2	26,49	TiO2
3	22,67	MgF2
4	77,25	TiO2
5	15,72	MgF2
6	36,72	TiO2
7	49,66	MgF2
8	12,41	TiO2
9	151,24	MgF2
10	1,66	TiO2
11	61,34	MgF2

Result:

reflectance



# of layers: 11
# of materials: 2
Ⓧ total thickness (<= 2000 nm): 569.5 nm
○ thickness of TiO2-layers (<=150 nm): 154.5 nm
Ⓧ Max Ro (< 1%): 0.57 %
○ Max (Rs + Rp)/2 (< 1%): 1.01 %

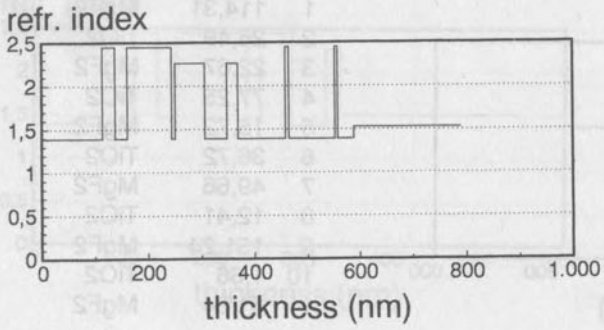
Meritfunction: $5.502 * 10^{-3}$

IEN_1.DRW

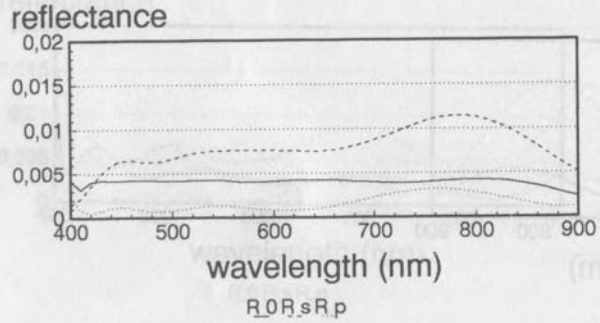
Author: M. L. Rastello
Instituto Elettrotecnico Nazionale
Strada delle Cacce 91
I 10135 Torino, Italy

Design category A:

#	nm	material
1	113,97	MgF2
2	24,98	TiO2
3	22,09	MgF2
4	83,42	TiO2
5	6,24	MgF2
6	56,03	Ta2O5
7	41,6	MgF2
8	21,26	Ta2O5
9	88,87	MgF2
10	7,28	TiO2
11	86,79	MgF2
12	6,22	TiO2
13	30,61	MgF2



Result:



# of layers: 13
# of materials: 3
⊗ total thickness (<= 2000 nm): 589.4 nm
⊗ thickness of TiO2-layers (<=150 nm): 121.9 nm
⊗ Max Ro (< 1%): 0.42 %
⊗ Max (Rs + Rp)/2 (< 1%): 0.72 %

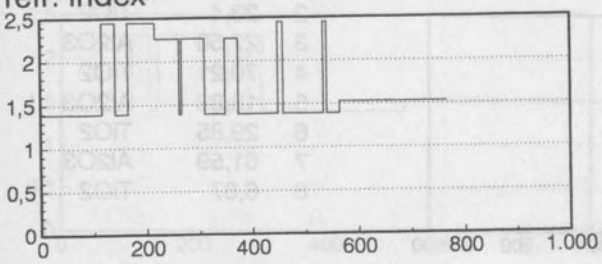
Meritfunction: $5.055 * 10^{-3}$

IEN_2.DRW

Author: M. L. Rastello
Instituto Elettrotecnico Nazionale
Strada delle Cacce 91
I 10135 Torino, Italy

Design category A:

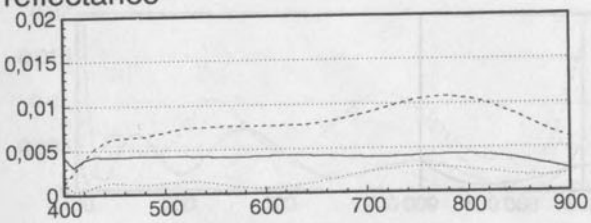
refr. index



#	nm	material
1	115,31	MgF2
2	25,5	TiO2
3	24,11	MgF2
4	51,21	TiO2
5	46,13	Ta2O5
6	3,93	MgF2
7	43,76	Ta2O5
8	38,76	MgF2
9	25,04	Ta2O5
10	74,85	MgF2
11	10,8	TiO2
12	74,66	MgF2
13	6,91	TiO2
14	24,27	MgF2

Result:

reflectance



# of layers: 14
# of materials: 3
⊗ total thickness (<= 2000 nm): 565.2 nm
⊗ thickness of TiO2-layers (<=150 nm): 94.4 nm
⊗ Max Ro (< 1%): 0.43 %
⊗ Max (Rs + Rp)/2 (< 1%): 0.67 %

Meritfunction: $5.061 * 10^{-3}$

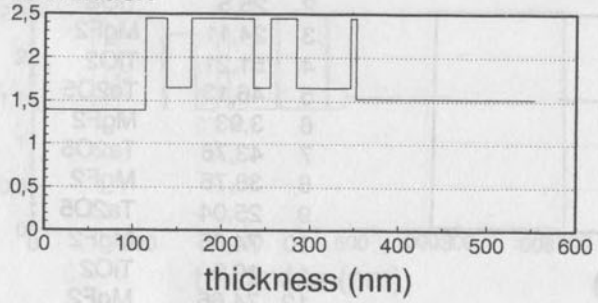
IEN_3.DRW

Author: U. Schallenberg
Fraunhofer-Einrichtung für Angewandte Optik und Feinmech.
Schillerstr. 1
O-6900 Jena, FRG

Design category A:

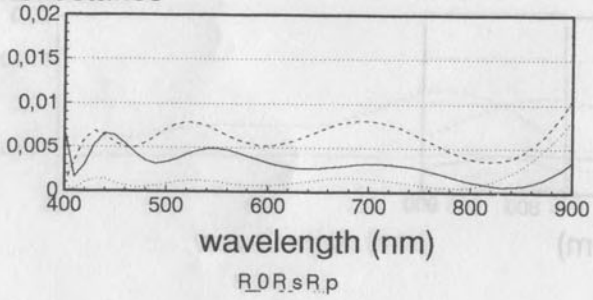
#	nm	material
1	113,99	MgF2
2	23,4	TiO2
3	27,58	Al2O3
4	70,21	TiO2
5	18,88	Al2O3
6	29,85	TiO2
7	61,59	Al2O3
8	6,87	TiO2

refr. index



Result:

reflectance



# of layers:	8
# of materials:	3
⊗ total thickness (<= 2000 nm):	352.3 nm
⊗ thickness of TiO2-layers (<= 150 nm):	130.3 nm
⊗ Max Ro (< 1%):	0.70 %
⊗ Max (Rs + Rp)/2 (< 1%):	0.94 %

Meritfunction: $4.094 * 10^{-3}$

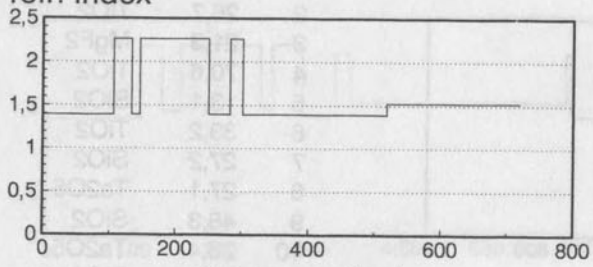
SCHA1.DRW

Author: M. Schulz - Grossar
Spindler & Hoyer GmbH & Co
Königsallee 23
D 3400 Göttingen, Germany

Design category A:

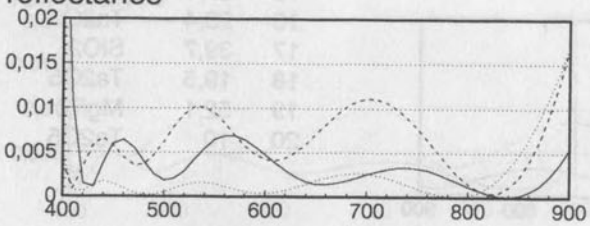
#	nm	material
1	106,81	MgF2
2	26,74	Ta2O5
3	12,26	MgF2
4	104,14	Ta2O5
5	32,28	MgF2
6	18,97	Ta2O5
7	217,31	MgF2

refr. index



Result:

reflectance



# of layers: 7
# of materials: 2
Ⓧ total thickness (<= 2000 nm): 518.5 nm
Ⓧ thickness of TiO2-layers (<=150 nm): 0 nm
○ Max Ro (< 1%): 3.61 %
○ Max (Rs + Rp)/2 (< 1%): 1.70 %

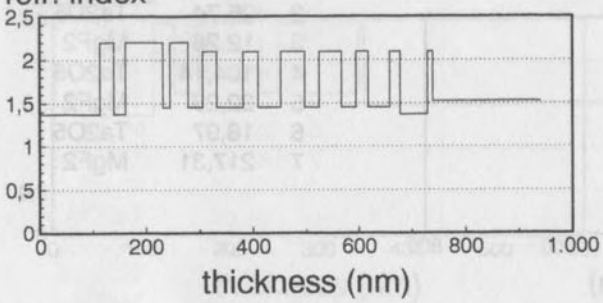
Meritfunction: $5.370 * 10^{-3}$

SPIN1.DRW

Author: J.E. Simpson
EMF Corporation
701 Spencer Rd.
Ithaca, NY 14850, US

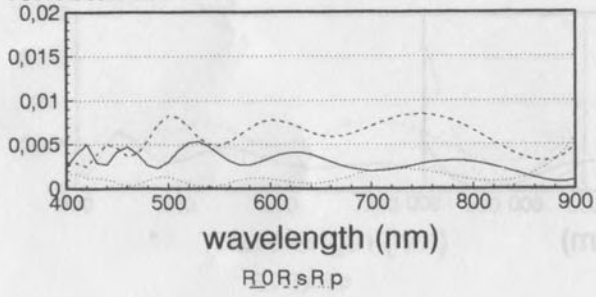
Design category A:

refr. index



Result:

reflectance



#	nm	material
1	113,2	MgF2
2	26,7	TiO2
3	21,3	MgF2
4	70,6	TiO2
5	13,1	SiO2
6	33,2	TiO2
7	27,2	SiO2
8	27,1	Ta2O5
9	48,3	SiO2
10	28,4	Ta2O5
11	43,6	SiO2
12	44,8	Ta2O5
13	26,8	SiO2
14	43,2	Ta2O5
15	27,1	SiO2
16	23,4	Ta2O5
17	39,7	SiO2
18	19,5	Ta2O5
19	52,1	MgF2
20	10	Ta2O5

# of layers: 20
# of materials: 4
⊗ total thickness (<= 2000 nm): 739.3 nm
⊗ thickness of TiO2-layers (<= 150 nm): 130.5 nm
⊗ Max Ro (< 1%): 0.53 %
⊗ Max (Rs + Rp)/2 (< 1%): 0.54 %

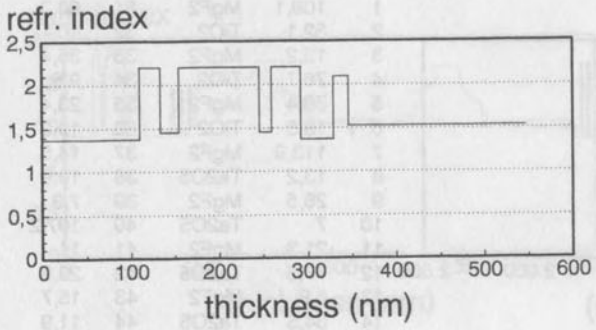
Meritfunction: $3.920 * 10^{-3}$

EMF1.DRW

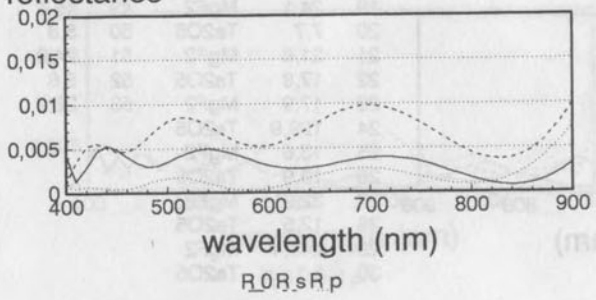
Author: J.E. Simpson
EMF Corporation
701 Spencer Road
Ithaca, NY 14850, US

Design category A:

#	nm	material
1	109,9	MgF2
2	23,5	TiO2
3	21	SiO2
4	91,5	TiO2
5	13,6	SiO2
6	33	TiO2
7	37	MgF2
8	17	Ta2O5



Result:



# of layers: 8
# of materials: 4

⊗ total thickness (<= 2000 nm):	346.5 nm
⊗ thickness of TiO2-layers (<= 150 nm):	148.0 nm
⊗ Max Ro (< 1%):	0.54 %
⊗ Max (Rs + Rp)/2 (< 1%):	0.87 %

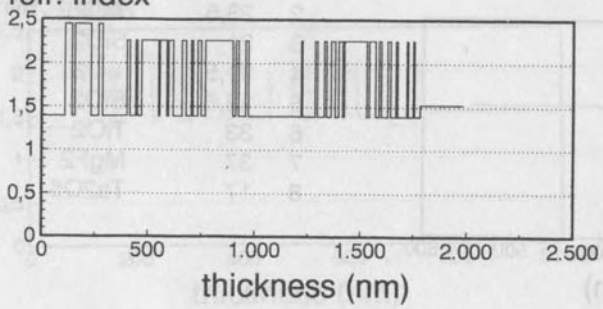
Meritfunction: $4.268 * 10^{-3}$

EMF2.DRW

Author: W.H. Southwell
Rockwell International Science Center
1049 Camino das Rios
Thousand Oaks, California 91360, US

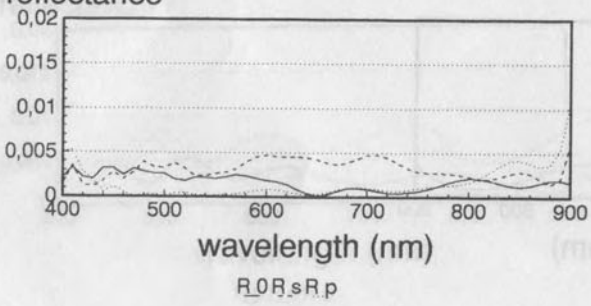
Design category A:

refr. index



Result:

reflectance



#	nm	material	#	nm	material
1	109,1	MgF2	31	60,3	MgF2
2	32,1	TiO2	32	10,1	Ta2O5
3	13,2	MgF2	33	35,4	MgF2
4	76,7	TiO2	34	9,6	Ta2O5
5	36,4	MgF2	35	23,4	MgF2
6	18,5	TiO2	36	19,2	Ta2O5
7	113,9	MgF2	37	14,5	MgF2
8	13,2	Ta2O5	38	19,9	Ta2O5
9	28,5	MgF2	39	7,9	MgF2
10	7	Ta2O5	40	107,2	Ta2O5
11	21,3	MgF2	41	11	MgF2
12	77,5	Ta2O5	42	29,3	Ta2O5
13	5,9	MgF2	43	15,7	MgF2
14	34,5	Ta2O5	44	11,9	Ta2O5
15	8,3	MgF2	45	31,1	MgF2
16	21,1	Ta2O5	46	13,3	Ta2O5
17	41,6	MgF2	47	24,7	MgF2
18	18,3	Ta2O5	48	6,6	Ta2O5
19	24,1	MgF2	49	45,4	MgF2
20	7,7	Ta2O5	50	5,8	Ta2O5
21	21,8	MgF2	51	24,9	MgF2
22	17,8	Ta2O5	52	5,6	Ta2O5
23	17,9	MgF2	53	25,2	MgF2
24	129,9	Ta2O5			
25	13,6	MgF2			
26	13,9	Ta2O5			
27	32,9	MgF2			
28	12,5	Ta2O5			
29	248,4	MgF2			
30	5,1	Ta2O5			

# of layers: 53
# of materials: 3
⊗ total thickness (<= 2000 nm): 1780.7 nm
⊗ thickness of TiO2-layers (<= 150 nm): 127.3 nm
⊗ Max Ro (< 1%): 0.43 %
⊗ Max (Rs + Rp)/2 (< 1%): 0.82 %

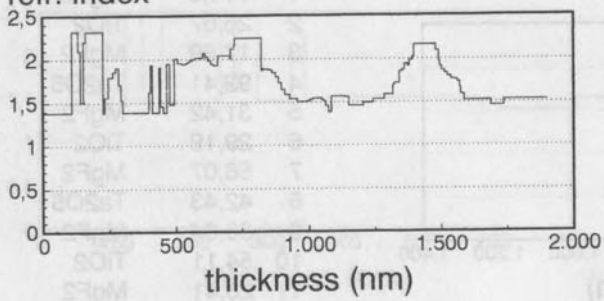
Meritfunction: $2.426 * 10^{-3}$

SOUT1.DRW

Author: W.H. Southwell
Rockwell International Science Center
1049 Camino das Rios
Thousand Oaks, California 91360, US

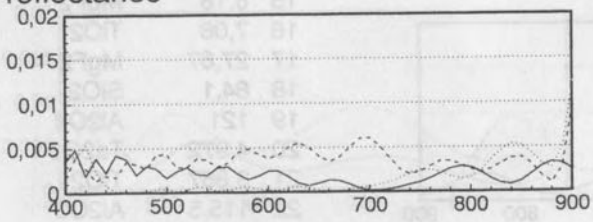
Design category B:

refr. index



Result:

reflectance



# of layers: 88

#	nm	material	#	nm	material
1	108,8	1,38	45	12,2	1,8406
2	23,8	2,32	46	12,1	1,7916
3	8,8	2,1033	47	11	1,7223
4	11,8	1,5065	48	12	1,6481
5	8,3	2,2081	49	17,5	1,5827
6	64,8	2,32	50	28,8	1,5342
7	6,8	1,38	51	37	1,504
8	13,1	1,5596	52	10,6	1,5127
9	17	1,7904	53	12,1	1,5293
10	12	1,8528	54	35,2	1,547
11	9,9	1,8965	55	5,4	1,527
12	7,9	1,7028	56	6,7	1,5121
13	7,4	1,5272	57	10,5	1,46
14	99,5	1,38	58	12,6	1,38
15	6,1	1,6194	59	50	1,5615
16	6	1,9316	60	14,8	1,5539
17	25,6	1,38	61	54,2	1,46
18	5,1	1,9021	62	36,6	1,4925
19	11,6	1,46	63	42,4	1,5315
20	11,9	1,38	64	32	1,584
21	11,8	1,9455	65	5,3	1,6899
22	17,1	1,4769	66	20,8	1,72
23	14,8	2,005	67	10,5	1,8547
24	14,2	1,9523	68	8,9	1,8716
25	10,5	1,9373	69	10,1	1,9422
26	8,7	1,9481	70	8,1	1,9147
27	9,1	1,9613	71	9,6	1,9804
28	10,4	1,9778	72	5,9	2,019
29	12,1	1,9985	73	83,9	2,16
30	28,6	2,016	74	11,6	2,0902
31	8,3	2,0643	75	3,5	1,9723
32	9,3	2,0296	76	7,4	1,9153
33	11,1	1,9788	77	10	1,8639
34	10,4	1,9431	78	11,5	1,8313
35	17	1,924	79	12,5	1,8004
36	44,9	2,0418	80	12,9	1,765
37	3,7	2,0066	81	11	1,7561
38	12,7	2,1225	82	9,7	1,7323
39	1,4	2,1583	83	5	1,67
40	101,8	2,24	84	6,9	1,5922
41	3,8	1,8679	85	4,4	1,5815
42	5,9	1,8858	86	1,1	1,5589
43	19,1	1,8765	87	100,8	1,516
44	10,3	1,8684	88	47,5	1,46

⊗	total thickness (<= 2000 nm):	1736 nm
⊗	thickness of TiO2-layers (<= 150 nm):	142.0 nm
⊗	Max Ro (< 1%):	0.49 %
○	Max (Rs + Rp)/2 (< 1%):	1.03 %

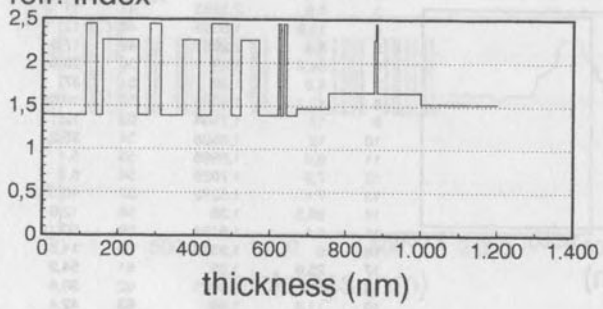
Meritfunction: $2.721 * 10^{-3}$

SOUT2.DRW

Author: R. Sperger
Balzers AG
FL 9496 Balzers, Liechtenstein

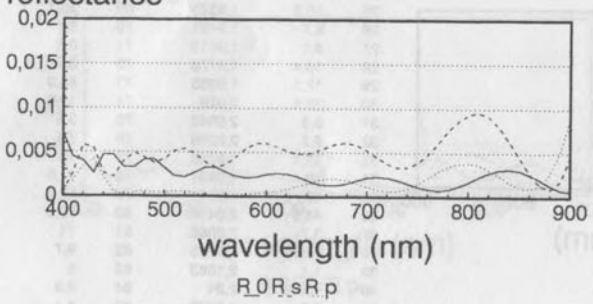
Design category A:

refr. index



Result:

reflectance



#	nm	material
1	114,3	MgF2
2	26,67	TiO2
3	17,89	MgF2
4	92,41	Ta2O5
5	31,42	MgF2
6	29,19	TiO2
7	56,07	MgF2
8	42,43	Ta2O5
9	33,04	MgF2
10	54,11	TiO2
11	23,41	MgF2
12	48,44	Ta2O5
13	52,28	MgF2
14	5,06	TiO2
15	8,18	MgF2
16	7,08	TiO2
17	27,67	MgF2
18	84,1	SiO2
19	121	Al2O3
20	4,972	Ta2O5
21	3,867	TiO2
22	115,5	Al2O3

# of layers: 22
# of materials: 5

⊗ total thickness (<= 2000 nm):	999.0 nm
⊗ thickness of TiO2-layers (<=150 nm):	126.0 nm
⊗ Max Ro (< 1%):	0.71 %
⊗ Max (Rs + Rp)/2 (< 1%):	0.67 %

Meritfunction: $3.407 * 10^{-3}$

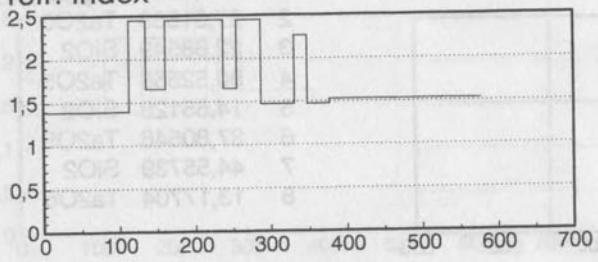
BALZ1.DRW

Author: D. Spindler
GIAT Industries
13, route de la Minière
78022 Versailles Cedex, France

Design category A:

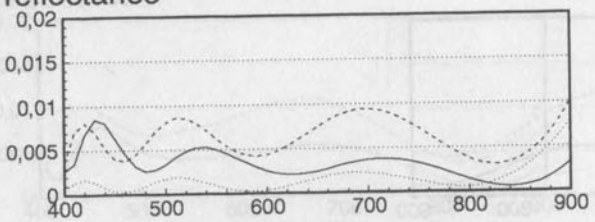
#	nm	material
1	112,5	MgF2
2	22,8	TiO2
3	25,9	Al2O3
4	76,6	TiO2
5	17,4	Al2O3
6	32,7	TiO2
7	43	SiO2
8	17,3	Ta2O5
9	28,7	SiO2

refr. index



Result:

reflectance



# of layers: 9
# of materials: 5
⊗ total thickness (<= 2000 nm): 376.9 nm
⊗ thickness of TiO2-layers (<= 150 nm): 132.1 nm
⊗ Max Ro (< 1%): 0.86 %
⊗ Max (Rs + Rp)/2 (< 1%): 0.90 %

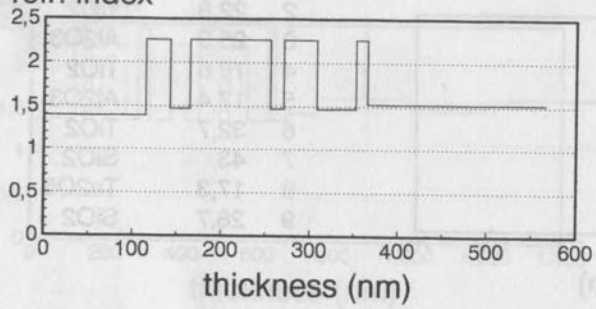
Meritfunction: $4.304 * 10^{-3}$

GIAT1.DRW

Author: B.T. Sullivan
Institute for Microstructural Sciences
Ottawa, Canada

Design category A:

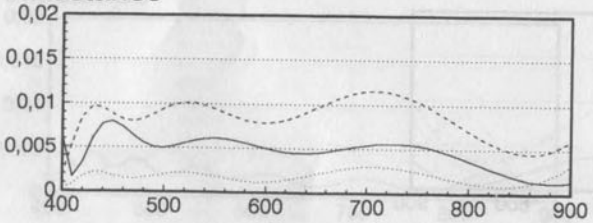
refr. index



#	nm	material
1	114,60678	MgF2
2	27,21569	Ta2O5
3	22,68549	SiO2
4	90,52556	Ta2O5
5	14,65128	SiO2
6	37,80546	Ta2O5
7	44,55739	SiO2
8	13,17704	Ta2O5

Result:

reflectance



R_0 R_s R_p

# of layers:	8
# of materials:	3
⊗ total thickness (<= 2000 nm):	365.2 nm
⊗ thickness of TiO2-layers (<= 150 nm):	0 nm
⊗ Max Ro (< 1%):	0.80 %
⊗ Max (Rs + Rp)/2 (< 1%):	0.73 %

Meritfunction: $5.653 * 10^{-3}$

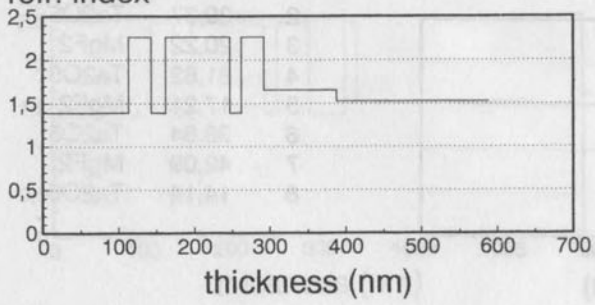
NRC_1.DRW

Author: V.A. Trevino
PAGE Iberica SA
Avda. de la Industria
38760 Tres Cantos (Madrid), Spain

Design category A:

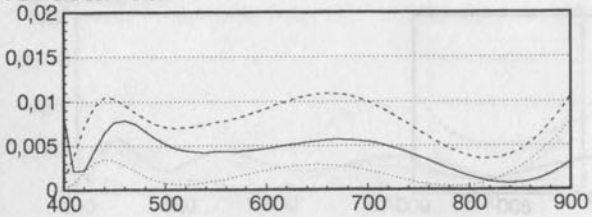
#	nm	material
1	113,2	MgF2
2	29,24	Ta2O5
3	19,69	MgF2
4	85,07	Ta2O5
5	14,95	MgF2
6	30,17	Ta2O5
7	95,37	Al2O3

refr. index



Result:

reflectance



# of layers: 7
# of materials: 3
Ⓧ total thickness (<= 2000 nm): 387.7 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 0 nm
Ⓧ Max Ro (< 1%): 0.82 %
Ⓧ Max (Rs + Rp)/2 (< 1%): 0.92 %

Meritfunction: $5.268 * 10^{-3}$

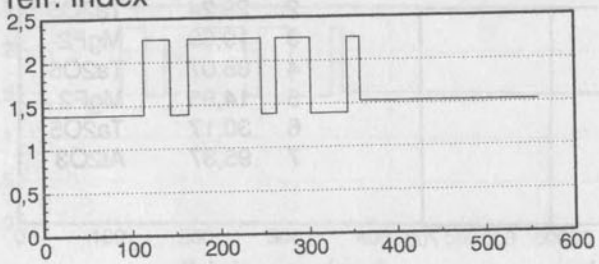
PAGE1.DRW

Author: V.A. Trevino
PAGE Iberica SA
Avda. de la Industria 26
28760 Tres Cantos (Madrid), Spain

Design category A:

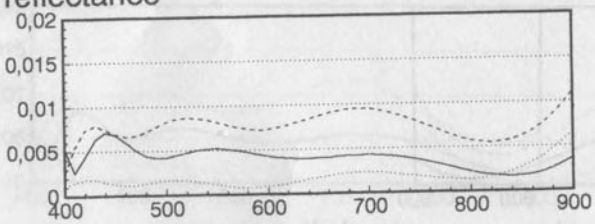
#	nm	material
1	113,9	MgF2
2	30,37	Ta2O5
3	20,22	MgF2
4	81,82	Ta2O5
5	17,21	MgF2
6	38,84	Ta2O5
7	42,09	MgF2
8	14,14	Ta2O5

refr. index



Result:

reflectance



# of layers:	8
# of materials:	2
⊗ total thickness (<= 2000 nm):	358.6 nm
⊗ thickness of TiO2-layers (<= 150 nm):	0 nm
⊗ Max Ro (< 1%):	0.71 %
⊗ Max (Rs + Rp)/2 (< 1%):	0.88 %

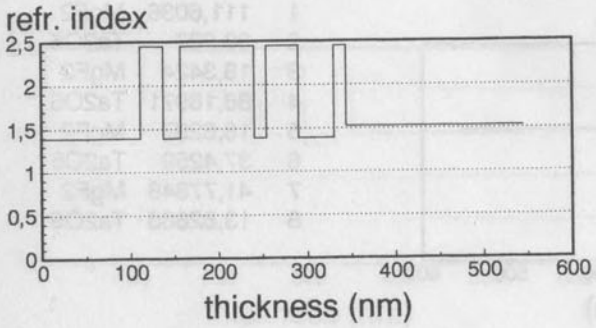
Meritfunction: $4.969 * 10^{-3}$

PAGE2.DRW

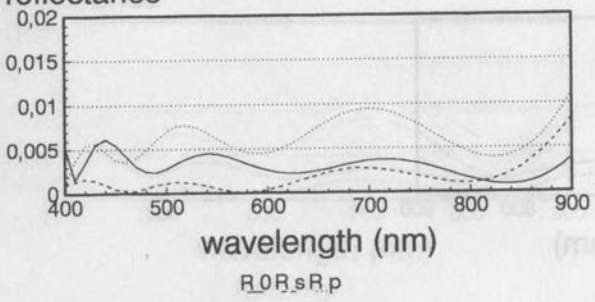
Author: M. Trubetskov
Science Research Computer Center
Lenin Hills
119899 Moscow, USSR

Design category A:

#	nm	material
1	111,4967	MgF2
2	26,1023	TiO2
3	19,68352	MgF2
4	83,01937	TiO2
5	13,81614	MgF2
6	36,15935	TiO2
7	39,8848	MgF2
8	13,71961	TiO2



Result:



	# of layers:	8
	# of materials:	2
⊗	total thickness (<= 2000 nm):	343.9 nm
○	thickness of TiO2-layers (<= 150 nm):	159.0 nm
⊗	Max Ro (< 1%):	0.62 %
⊗	Max (Rs + Rp)/2 (< 1%):	0.97 %

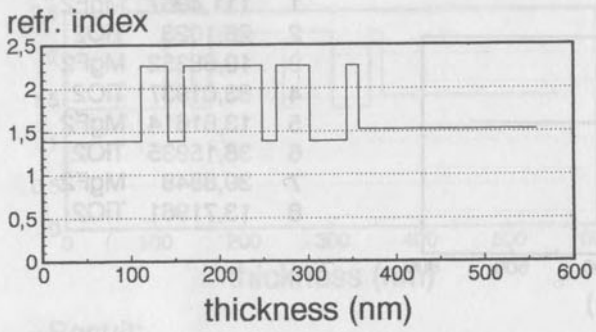
Meritfunction: $4.122 * 10^{-3}$

SRCC1.DRW

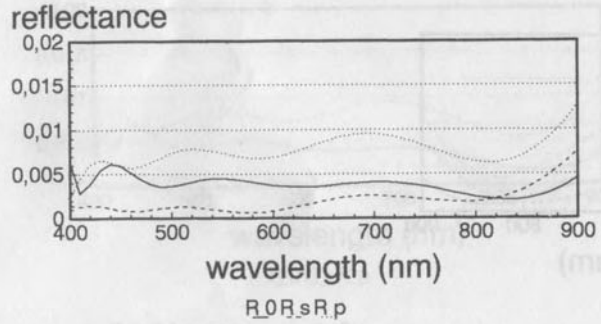
Author: M. Trubetskov
Science Research Computer Center
Lenin Hills
119899 Moscow, USSR

Design category A:

#	nm	material
1	111,6036	MgF2
2	30,287	Ta2O5
3	18,3424	MgF2
4	88,18971	Ta2O5
5	16,6287	MgF2
6	37,4259	Ta2O5
7	41,77848	MgF2
8	13,82888	Ta2O5



Result:



	# of layers:	8
	# of materials:	2
Ⓧ	total thickness (<= 2000 nm):	358.1 nm
Ⓧ	thickness of TiO2-layers (<= 150 nm):	0 nm
Ⓧ	Max Ro (< 1%):	0.63 %
○	Max (Rs + Rp)/2 (< 1%):	1.02 %

Meritfunction: $4.858 * 10^{-3}$

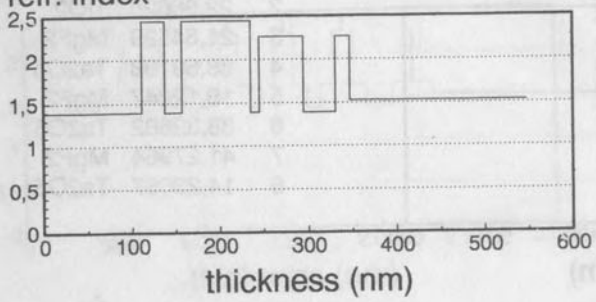
SRCC2.DRW

Author: M. Trubetskov
Science Research Computer Center
Lenin Hills
119899 Moscow, USSR

Design category A:

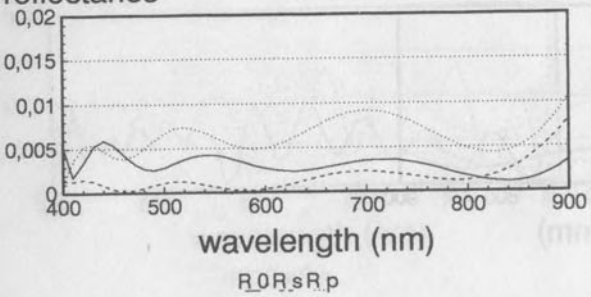
#	nm	material
1	111,3627	MgF2
2	26,05221	TiO2
3	19,79334	MgF2
4	78,23043	TiO2
5	9,602624	MgF2
6	49,86601	Ta2O5
7	36,15038	MgF2
8	16,13213	Ta2O5

refr. index



Result:

reflectance



# of layers: 8
# of materials: 3

⊗ total thickness (<= 2000 nm): 347.2 nm
⊗ thickness of TiO2-layers (<= 150 nm): 104.3 nm
⊗ Max Ro (< 1%): 0.59 %
⊗ Max (Rs + Rp)/2 (< 1%): 0.94 %

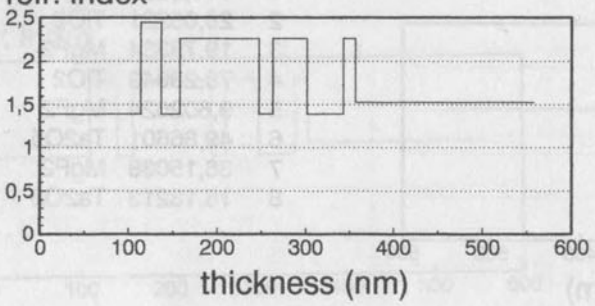
Meritfunction: $4.095 * 10^{-3}$

SRCC3.DRW

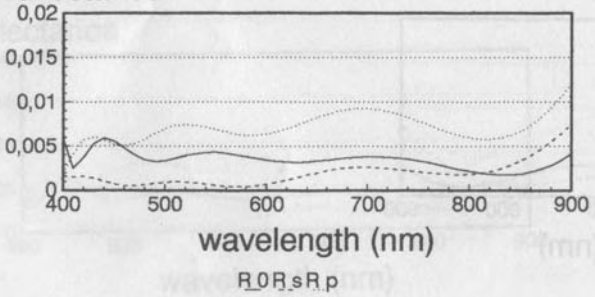
Author: M. Trubetskov
Science Research Computer Center
Lenin Hills
119899 Moscow, USSR

Design category A:

#	nm	material
1	113,5807	MgF2
2	22,96626	TiO2
3	21,64529	MgF2
4	88,59198	Ta2O5
5	16,12047	MgF2
6	38,32682	Ta2O5
7	41,27964	MgF2
8	14,23067	Ta2O5



Result:



# of layers:	8
# of materials:	3
⊗ total thickness (<= 2000 nm):	356.7 nm
⊗ thickness of TiO2-layers (<= 150 nm):	23.0 nm
⊗ Max Ro (< 1%):	0.59 %
⊗ Max (Rs + Rp)/2 (< 1%):	0.98 %

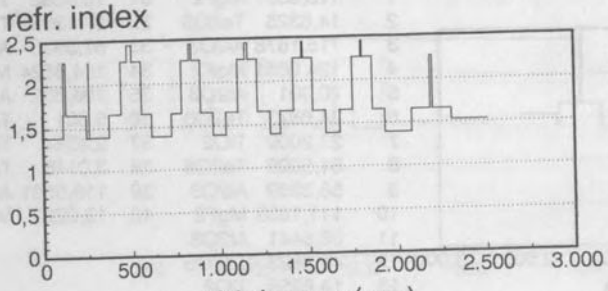
Meritfunction: $4.586 * 10^{-3}$

SRCC4.DRW

Author: R.R. Willey
OMI Opto Mechanik Inc
425 North Drive
Melbourne, FL 32936, US

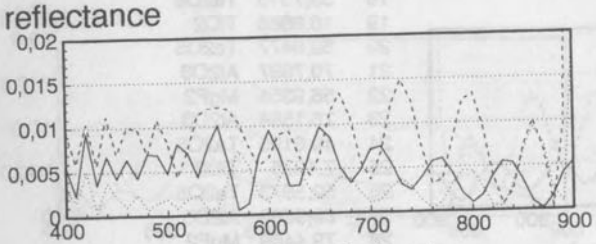
Design category A:

refr. index



Result:

reflectance



#	nm	material	#	nm	material
1	114,6106	MgF2	31	78,9889	MgF2
2	2,2879	Al2O3	32	73,048	Al2O3
3	12,8444	Ta2O5	33	48,179	Ta2O5
4	114,3058	Al2O3	34	8,6997	TiO2
5	16,67	MgF2	35	56,5904	Ta2O5
6	1,1248	Ta2O5	36	68,6721	Al2O3
7	108,7626	MgF2	37	150,8967	MgF2
8	71,1562	Al2O3	38	103,4236	Al2O3
9	35,0475	Ta2O5	39	12,121	Ta2O5
10	27,2919	TiO2	40	106,2954	Al2O3
11	51,1596	Ta2O5			
12	56,8014	Al2O3			
13	111,1129	MgF2			
14	58,5995	Al2O3			
15	46,134	Ta2O5			
16	15,0414	TiO2			
17	47,4266	Ta2O5			
18	67,8114	Al2O3			
19	73,3824	MgF2			
20	69,7884	Al2O3			
21	40,5811	Ta2O5			
22	16,675	TiO2			
23	53,5969	Ta2O5			
24	71,8337	Al2O3			
25	55,5615	MgF2			
26	75,7025	Al2O3			
27	50,1307	Ta2O5			
28	6,8386	TiO2			
29	52,1146	Ta2O5			
30	70,581	Al2O3			

# of layers: 40
# of materials: 4
◯ total thickness (<= 2000 nm): 2301 nm
Ⓧ thickness of TiO2-layers (<= 150 nm): 74.5 nm
◯ Max Ro (< 1%): 1.13 %
◯ Max (Rs + Rp)/2 (< 1%): 4.36 %

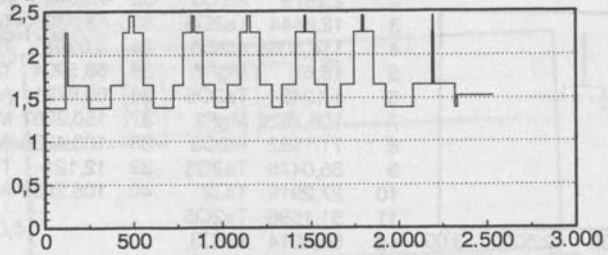
Meritfunction: $6.846 * 10^{-3}$

OMI_1.DRW

Author: R.R. Willey
OMI Opto Mechanik Inc
425 North Drive
Melbourne, FL 32936, US

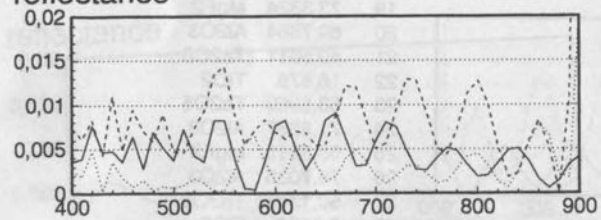
Design category A:

refr. index



Result:

reflectance



R_0 R_s R_p

#	nm	material	#	nm	material
1	115,8537	MgF2	31	10,4262	TiO2
2	14,8325	Ta2O5	32	57,1306	Ta2O5
3	116,1678	Al2O3	33	67,3938	Al2O3
4	124,6661	MgF2	34	154,8524	MgF2
5	70,091	Al2O3	35	106,632	Al2O3
6	34,6873	Ta2O5	36	5,361	Ta2O5
7	27,2009	TiO2	37	2,4384	TiO2
8	51,5005	Ta2O5	38	3,0146	Ta2O5
9	56,3369	Al2O3	39	118,5581	Al2O3
10	111,1833	MgF2	40	13,0222	MgF2
11	58,5441	Al2O3			
12	46,3623	Ta2O5			
13	14,8956	TiO2			
14	47,3205	Ta2O5			
15	67,6026	Al2O3			
16	72,4564	MgF2			
17	70,4659	Al2O3			
18	39,7515	Ta2O5			
19	16,8888	TiO2			
20	53,8477	Ta2O5			
21	70,7897	Al2O3			
22	56,9354	MgF2			
23	76,1584	Al2O3			
24	49,6195	Ta2O5			
25	7,1975	TiO2			
26	52,5873	Ta2O5			
27	69,9589	Al2O3			
28	79,4469	MgF2			
29	72,7923	Al2O3			
30	47,0343	Ta2O5			

# of layers: 40
# of materials: 4

○	total thickness (<= 2000 nm):	2332 nm
⊗	thickness of TiO2-layers (<= 150 nm):	79.0 nm
○	Max Ro (< 1%):	1.20 %
○	Max (Rs + Rp)/2 (< 1%):	4.49 %

Meritfunktion: $6.461 * 10^{-3}$

OMI_2.DRW

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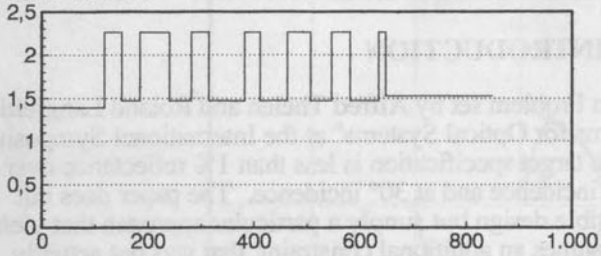
Newbury, Berkshire, UK RG16 OXT

T. Mooney
Barr Associates Inc
2 Liberty Way
Westford, MA 01886, US

Design category A:

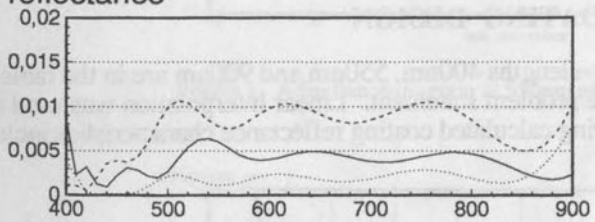
refr. index



#	nm	material
1	118	MgF2
2	32,15	Ta2O5
3	34,07	SiO2
4	55,88	Ta2O5
5	41,51	SiO2
6	32,98	Ta2O5
7	67,25	SiO2
8	30,1	Ta2O5
9	51	SiO2
10	43,69	Ta2O5
11	39,79	SiO2
12	34,71	Ta2O5
13	54,24	SiO2
14	13,02	Ta2O5

Result:

reflectance



# of layers: 14
# of materials: 3

⊗ total thickness (<= 2000 nm):	648 nm
⊗ thickness of TiO2-layers (<=150 nm):	0 nm
⊗ Max Ro (< 1%):	0.85 %
⊗ Max (Rs + Rp)/2 (< 1%):	0.91 %

Meritfunction: $5.080 * 10^{-3}$