

Internal distribution code:

- (A) Publication in OJ
(B) To Chairmen and Members
(C) To Chairmen
(D) No distribution

**Datasheet for the decision
of 21 September 2011**

Case Number: T 0942/06 - 3.3.05

Application Number: 98117464.2

Publication Number: 0908421

IPC: C03C 17/36

Language of the proceedings: EN

Title of invention:

High light transmission, low-e sputter-coated layer systems
and insulated glass units made therefrom

Patentee:

GUARDIAN INDUSTRIES CORP.

Opponents:

Pilkington Deutschland AG
BLUHM & PLATE AG
SAINT-GOBAIN GLASS FRANCE
Euroglas GmbH
AGC Flat Glass Europe

Headword:

Low-e glass/GUARDIAN INDUSTRIES CORP.

Relevant legal provisions:

EPC Art. 83, 104, 111(1)

Keyword:

"Sufficiency of disclosure (no) - gaps of information - lack
of guidance - no instruction by way of examples"

Decisions cited:

T 0435/91, T 0409/91

Catchword:

-



Case Number: T 0942/06 - 3.3.05

D E C I S I O N
of the Technical Board of Appeal 3.3.05
of 21 September 2011

Appellant 01: Pilkington Deutschland AG
(Opponent 01) Haydnstrasse 19
D-45884 Gelsenkirchen (DE)

Representative: -

Party as of right 01: BLUHM & PLATE KG
(Opponent 02) von Bronsart Strasse 14 - Postfach 1129
D-22885 Barsbüttel (DE)

Representative: Le Vaguerèse, Sylvain Jacques
AGC France 114 Bureaux de la Colline
F-92213 Saint-Cloud Cedex (FR)

Party as of right 02: SAINT-GOBAIN GLASS FRANCE
(Opponent 03) 18, avenue d'Alsace
F-92400 Courbevoie (FR)

Representative: Cardin, Elise
Saint-Gobain Recherche 39
quai Lucien Lefranc
F-93303 Aubervilliers Cedex (FR)

Appellant 02: Euroglas GmbH
(Opponent 04) Dammühlenweg 60
D-39340 Haldensleben (DE)

Representative: nospat Patent- und Rechtsanwälte Naefe
Oberdorfer Schmidt
Isartorplatz 5
D-80331 München (DE)

Appellant 03:
(Opponent 05) AGC Flat Glass Europe
Rue de l'Aurore 2
BE-6040 Jumet (BE)

Representative: Le Vaguerèse, Sylvain Jacques
AGC France 114 Bureaux de la Colline
F-92213 Saint-Cloud Cedex (FR)

Respondent: GUARDIAN INDUSTRIES CORP.
(Patent Proprietor) 2300 Harmon Road
Auburn Hills
Michigan 48326-1714 (US)

Representative: Hess, Peter K. G.
Patent- und Rechtsanwälte
Bardehle Pagenberg
Postfach 86 06 20
D-81633 München (DE)

Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted 12 May 2006
rejecting the opposition filed against European
patent No. 0908421 pursuant to Article 102(2)
EPC.**

Composition of the Board:

Chairman: G. Raths
Members: H. Engl
D. Prietzel-Funk

Summary of Facts and Submissions

- I. European patent EP-B-0 908 421 was granted with 22 claims.

Independent claims 1 and 18 are worded as follows:

"1. A glass article comprising a glass substrate having a sputter coated layer system thereon which from the glass outwardly consists essentially of:

- a) an undercoat layer formed of at least a metal oxide or nitride having an index of refraction comprised in the interval 2.35-2.75;
- b) optionally a lower intermediate layer located between said undercoat layer and said silver layer, wherein said lower intermediate layer is selected from an essentially stoichiometric oxide or nitride of Zn, Ti, Sn, Bi, Si or mixtures thereof;
- c) a layer of metallic silver; and
- d) an upper intermediate layer located between said silver layer and said overcoat layer, wherein said upper intermediate layer is selected from an oxide or a nitride of Al, Ti, Zn, Zr, Cr, Ta, Mg or mixtures thereof;
- e) an overcoat layer formed of at least a metal oxide or nitride having an index of refraction comprised in the interval 1.85-2.25;

wherein said undercoat layer has a thickness ranging

between 16 and 32 nm and said layer of metallic silver and said overcoat layer are chosen in combination of a thickness sufficient such that said glass article, when said glass substrate consists of a clear glass of a thickness comprised between 2-6 mm, has a visible transmittance (T_{vis}) of at least 84%, a sheet resistance (R_s) of less than or equal to 5.5 ohms/sq., and a normal emissivity (E_n) of less than or equal to 0.065 and wherein said layer system does not include any layer consisting essentially of a sub-stoichiometric metallic oxide located between the substrate and the layer of metallic silver."

"18. An insulating glass unit comprised of at least 2-panes of glass and sealed at their peripheral edges to form an insulating chamber in between them, at least one of said panes of glass being a glass sheet according to claims 2, 4, 13, 15, or 17, wherein said layer system on said glass sheet is located within a said insulating chamber and wherein said insulating glass unit exhibits the following characteristics:

$$\begin{aligned} T_{vis} & \geq 75\% \\ R_{outside} & \leq 15\% \\ R_{inside} & \leq 15\% \\ S.C. & \geq 0.060 \\ U_{winter} & \leq 0.26. \end{aligned}$$

- II. The European patent was opposed by five opponents, invoking the grounds of opposition according to Articles 100(a), (b) and (c) EPC.
- III. In the contested decision, the opposition division rejected the oppositions and maintained the European

patent as granted.

IV. With respect to the question of sufficiency of disclosure (Article 83 EPC), the opposition division argued that the claims were supported by two detailed working examples represented in Figures 1 and 2 and described in detail in paragraphs [0049] to [0055] of the patent. In particular, said working examples proved that the objectives of the invention as recited in paragraph [0017] of the specification in connection with the desiderata of claim 1 were met. Allegations of the opponents that the desired luminous transmittance could not be achieved was not sufficiently supported by conclusive evidence (see Reasons, point 21). Therefore, the opposed patent was held to meet the requirements of Article 83 EPC.

V. The present appeals, submitted by opponent 1 (= appellant 1), opponent 4 (= appellant 2) and opponent 5 (= appellant 3) lie against this decision of the opposition division.

VI. Cited documents

The parties cited numerous documents during opposition and appeal proceedings. A complete list of these documents can be found as an Annex to the board's communication dated 1 July 2011.

Documents explicitly referred to in the present decision are the following:

E1: US-A-5 563 734

E2: US-A-5 110 662

- E3: DE-A-195 20 843
- E5: G. Bräuer et al.: *"New Developments in High Rate Sputtering of Dielectric Materials"*, Proc. of the 3. ISSP, Tokyo, 1995
- E6: G.V. Samsonov, *"The Oxide Handbook"*, second Ed., IFI/Plenum, New York - Washington - London, pages 228 and 229
- E7: WO-A-99/00528
- E8: K. Okimura et al., *"Preparation of Rutile Films by RF Magnetron Sputtering"*, Japan. J. Appl. Phys. vol. 34(1995), pages 4950 to 4955
- E10: H. Schilling et al.: *"New Achievements in the Field of Coating Architectural Glass"*, Glass Processing Days, September 1997, pages 203 to 208
- E10a: *"Welcome Note"* Glass Processing Days, Fifth Int. Conference, 13 to 15 September 1997, Tampere, Finland (FI)
- E10b: Declaration of Dr. Norbert Wruk dated 20 October 2005, concerning E10
- E20: US-A-5 302 449
- E22: B. Ruegg, H. Schilling (Leybold-Heraeus), *"New low-E layer system based on TiO₂ in coating of architectural glass"*, Sonderdruck aus Glas-Ingenieur 7, 1997
- E35: Excerpt from: Hans-Joachim Gläser: *"Dünnschichttechnologie auf Flachglas"*, Verlag Karl Hofmann, Schorndorf, Germany, 1999
- E36: Tables 1, 2 and 3 with experimental results concerning modified example 1* of US-A-5 110 662

V1 - V4: Experimental Report on four glass panes prepared by appellant 1 according to the opposed patent, submitted with the grounds of appeal (pages 9 to 14)

Annex 4: A computer simulation carried out by appellant 3 (filed with letter dated 5 October 2006)

VII. The following written submissions of the opposing parties were received:

Appeal brief (reasons of appeal) of appellant 1 dated 21 September 2006;

Appeal brief (reasons of appeal) of appellant 2 dated 22 September 2006;

Appeal brief (reasons of appeal) of appellant 3 dated 22 September 2006;

A letter of appellant 2 dated 18 March 2008;

A letter of appellant 3 dated 15 May 2008;

A letter of party as of right 2 dated 18 August 2011;

A letter of appellant 3 dated 19 August 2011;

A letter of appellant 1 dated 22 August 2011;

A letter of appellant 2 dated 22 August 2011.

VIII. The patentee (respondent) submitted a letter dated 26 April 2007, including auxiliary requests 1 to 4, and a letter dated 8 August 2011.

IX. The independent claims of said four auxiliary requests are worded as follows:

Auxiliary request 1:

Claim 1 in accordance with auxiliary request 1 differs from claim 1 as granted in that sub-items a) and e)

thereof are modified to read:

"a) an undercoat layer formed of at least a metal oxide or nitride **of Ti, Zr, Pb, W or Si or mixtures or multiple layers thereof**, having an index of refraction comprised in the interval 2.35-2.75;"

"e) an overcoat layer formed of at least a metal oxide or nitride **of Zn, Sn, In, Si or mixtures or multiple layers thereof**, having an index of refraction comprised in the interval 1.85-2.25;"

Auxiliary request 2:

Claim 1 in accordance with auxiliary request 2 differs from claim 1 as granted in that sub-item b) thereof is modified to read:

"b) a lower intermediate layer located between said undercoat layer and said silver layer, wherein said lower intermediate layer is selected from an essentially stoichiometric oxide or nitride of Zn, Ti, Sn, Bi, Si or mixtures thereof **and has a thickness of no more than 15nm;**"

Auxiliary request 3:

Claim 1 in accordance with auxiliary request 3 differs from claim 1 as granted in that the following passage

"and said glass article exhibits a substantially neutral, non-purple color and a non-mirror-like reflectance whether viewed from the glass side or the film side"

is inserted between "equal to 0.065" and "and wherein said layer system does not include any layer".

Auxiliary request 4:

Claim 1 in accordance with auxiliary request 4 differs from claim 1 as granted in that sub-items a), b), c) and e) thereof are modified so as to read:

"a) an undercoat layer formed of at least a metal oxide or nitride **of Ti, Zr, Pb, W or Si or mixtures or multiple layers thereof**, having an index of refraction comprised in the interval 2.35-2.75;"

c) a silver layer of metallic silver **with a thickness of no more than 18nm**; and

"e) an overcoat layer formed of at least a metal oxide or nitride **of Zn, Sn, In, Si or mixtures or multiple layers thereof**, having an index of refraction comprised in the interval 1.85-2.25, **and a thickness of no more than 70 nm**;"

Amendments are highlighted in **bold** print, deletions are designated as **[]**.

Auxiliary requests 1 to 4 additionally each comprise an independent product claim relating to an insulating glass unit worded as granted claim 18, in the case of auxiliary request 3 appropriately renumbered as claim 17.

X. A communication of the board was issued on 1 July 2011 in which the board dealt with the written submissions of the parties.

In the preliminary opinion of the board several requests for evidence ("*Beweisanträge*") filed by appellant 2 with the appeal brief could not be entertained. In proceedings before the Boards of Appeal, the boards would generally take into consideration evidence brought before them in good time. It was however incumbent on the party alleging a certain fact to provide the evidence therefor. The board would actively acquire facts and evidence only under exceptional circumstances which do not appear to prevail here. The procurement of expert opinions by the board was also not required as the boards themselves possessed the necessary expertise due to their being composed of both legally and technically qualified members.

Furthermore, concerning a request by appellant 2 to the effect that the board should order the surrender of certain samples prepared by the respondent in connection with examples I and I* of E2 (letter of 18 March 2008, paragraph bridging pages 5 and 6), the board considered such a request inadmissible for lack of a legal basis in the EPC.

The board also drew attention to the following points:

The hearing of the witnesses was requested by party as of right 2 apparently only if the written evidence was disputed which was not the case. The same appeared to be the case regarding the witness nominated by

appellant 2. The board therefore communicated its intention not to summon any witnesses for the oral hearing scheduled for 21 and 22 September 2011.

XI. Oral proceedings took place on 21 September 2011. Appellant 1 withdrew its request that the appeal fee be reimbursed.

XII. The arguments of appellant 1, insofar as they are relevant for the present decision, may be summarized as follows:

Article 100(b) EPC:

The experiments V1 to V4 carried out by appellant 1 proved that it was impossible to achieve a transparency of 87% or 89% in a coated article of neutral colour having a Ag layer of 16.5 nm (which was used in examples 1 and 2 of the opposed patent). The appellant dismissed the respondent's counter-argument that incomplete oxidation of the upper intermediate layer could have been responsible for the observed behaviour. It maintained that a TiO₂ layer having a refractive index exceeding 2.45 was impossible to achieve by using standard sputtering techniques. Even under conditions involving an additional oxidising heat treatment, the high refractive index of the examples could not be reproduced.

XIII. The essential arguments of appellant 3 were as follows:

Article 100(b) EPC:

Appellant 3 referred to the tests V1 to V4 carried out

by the appellant 1 proving that it was impossible to achieve a transparency of 87% or 89% in a coated article of neutral colour having a silver layer of 16.5 nm (as used in the examples of the opposed patent). In particular, it attributed the lower values of T_{vis} found in said tests to the fact that a TiO_2 layer having a refractive index as high as 2.56, as reported in the opposed patent's examples, could not be obtained, not even by applying an additional oxidising heat treatment which was neither disclosed in the opposed patent nor conventional in the art.

Although the computer simulation carried out by appellant 3 (Annex 4 to the letter dated 5 October 2006) yielded values of T_{vis} and emissivity comparable to those reported in examples 1 and 2 of the opposed patent, these findings were based on the assumption that a TiO_2 layer having a refractive index of 2.56 could actually be prepared by conventional means. However, that this was not the case had not been disputed by the respondent. It was known from E10 that deposition of TiO_2 by conventional low-speed DC sputtering resulted in an anatase or amorphous modification having a low refractive index of 2.4 to 2.45. For depositing the high refractive rutile modification a special "Twin-Mag" process and a high-speed deposition were necessary, which were not conventional. The opposed patent failed to disclose such special deposition conditions, and hence, failed to teach how to obtain the required highly refractive rutile form of TiO_2 .

XIV. Appellant 2 concurred with appellants 1 and 3 in their arguments concerning insufficiency of disclosure.

XV. Party as of right 2 essentially argued as follows:

The claimed subject-matter differed from E10/E22 only in that the thickness of 16 to 32 nm for the underlayer was not disclosed and in that T_{vis} exceeded 84%. However, the latter claim feature was not a technical characteristic, but a property to be achieved.

The problem as defined in the opposed patent consisted in providing a coating system having the desired transmissivity, emissivity and resistance values as well as a neutral colour.

However, the examples of the patent itself showed that a neutral colour was not achieved, because the values a and b were, respectively, positive and negative, and the reflective colour thus purple.

XVI. The respondent's essential arguments may be summarized as follows:

The respondent requested that late-filed evidence not considered by the opposition division and evidence late-filed in appeal proceedings not be admitted.

Article 100(c) EPC

The respondent dismissed the objections under Article 123(2) EPC as unfounded.

Article 100(b) EPC:

The respondent dismissed the objection of lack of disclosure based on the negative test results obtained by appellant 1. It argued that possibly incomplete oxidation of the intermediate TiO_x layer had taken place, as unoxidized metallic Ti was known to be highly absorbing. The respondent also noted that appellant 2 had obtained favourable results very similar to those of the patent in its simulation of examples 1 and 2. The respondent argued that according to the statements of opponents 1 and 4, no problem of reproducibility arose at all with thinner silver layers of 10 and 12 nm thickness. Appellant 2 had even presented experimental proof that the layer system no. 6 was in full accordance with claim 1 of the opposed patent (see E36).

Moreover, even if one or both of the specific examples of the opposed patent could not, or only with difficulty, be reworked - which was denied - , the claimed invention was still sufficiently disclosed in the description (e.g. page 20, line 10 to page 24, line 14), giving clear advise how the single layers of the inventive stack had to be prepared.

XVII. Requests:

Appellant 1, party as of right 2 (opponent 3), appellant 2 and appellant 3 requested that the European patent be revoked.

Party as of right 1 (opponent 2) did not file any requests.

The respondent requested that the appeals be dismissed

and the patent be upheld as granted; or, in the alternative, that the patent be maintained in amended form on the basis of one of the sets of claims filed under cover of a letter dated 26 April 2007 as auxiliary requests 1 to 4. The respondent also requested not to admit late filed evidence. Should late filed evidence nevertheless be admitted, it requested to remit the case to the department of first instance and to apportion costs incurred in oral proceedings before the board of appeal.

Reasons for the Decision

1. Amendments

The opposing parties filed numerous objections under Article 123(2) EPC, both against the claims as granted and against the amended claims in accordance with auxiliary requests 1 to 4.

The board found none of these objections well-founded and decided in the oral proceedings that the requirements of Article 123(2) EPC were met.

It is not necessary to provide a detailed reasoning in this respect here because the patent cannot be maintained for other reasons.

2. Admissibility of certain submissions

Experimental report V1 to V4 concerns a reworking of examples 1 and 2 of the opposed patent, submitted by appellant 1 with the statement of grounds of appeal.

The board considers that these new submissions were made in an effort to invalidate the arguments of the opposition division in the contested decision. They are thus admissible.

3. Sufficiency of disclosure (Article 83 EPC)

3.1 *The requirement of sufficiency of disclosure*

According to the established jurisprudence of the boards of appeal, the requirement of sufficiency of disclosure is only met provided the invention as defined in the independent claim can be performed by the person skilled in the art within the whole area claimed without the burden of an undue amount of experimentation, taking into consideration common general knowledge and the whole information content of the patent in suit (see decision T 435/91, OJ EPO 1995, 188, point 2.2.1, third paragraph, of the Reasons; and T 409/91, OJ EPO 1994, 653, point 2, first paragraph, penultimate sentence).

3.2 *The invention*

3.2.1 The claimed invention aims at providing coating systems for glass substrates which exhibit high visible transmission, very low emissivity values and which are substantially neutral in colour (see paragraphs [0001] and [0017]). Additionally, claim 1 as granted also recites as *desiderata* that the visible transmittance (T_{vis}) of the coating system, when applied to a clear glass having a thickness comprised between 2 to 6 mm, is at least 84%, the sheet resistance (R_s) is less than

or equal to 5.5 ohms/sq. and the normal emissivity (E_n) is less than or equal to 0.065.

The layer system in accordance with the claimed invention thus aims at achieving a combination of high T_{vis} and at the same time low E_n and low R_s (see paragraph [0037]). Moreover, although not specifically claimed, the sputter coated glass article should have a substantially neutral visible reflected colour (*i.e.* colourless to slightly blue and non-purple) when viewed from the glass side, and a substantially non-mirror-like reflectance (see paragraphs [0003] and [0040]). The skilled person thus has to arrive at the simultaneous achievement of these properties.

3.2.2 In order to obtain these objectives, a multi-layer sputter-coated system according to claim 1 comprises the following essential layers a), c), d) and e) from the glass outwardly, defined in structural terms:

- a) an undercoat layer formed of at least a metal oxide or nitride having an index of refraction comprised in the interval 2.35 - 2.75 and a thickness of 16 to 32 nm;
- c) a layer of metallic silver;
- d) an upper intermediate layer located between said silver layer and said overcoat layer, wherein said upper intermediate layer is selected from an oxide or a nitride of Al, Ti, Zn, Zr, Cr, Ta, Mg or mixtures thereof; and
- e) an overcoat layer formed of at least a metal oxide or nitride having an index of refraction comprised in the interval 1.85 - 2.25.

Claim 1 also comprises, as functional features or *desiderata*, the requirements that:

f) said layer of metallic silver and said overcoat layer are chosen in combination of a thickness sufficient such that said glass article, when said glass substrate consists of a clear glass of a thickness comprised between 2-6 mm, has a visible transmittance (T_{vis}) of at least 84%, a sheet resistance (R_s) of less than or equal to 5.5 ohms/sq., and a normal emissivity (E_N) of less than or equal to 0.065.

Therefore, in accordance with claim 1 as granted, the layers and their respective thicknesses have to be selected - within the limits of structural claim features a) to e) - such that the optical and physical properties of the so coated glass article satisfy functional claim feature f).

3.2.3 It is known in the art that at least some of the above defined desired optical and physical characteristics are in mutual conflict. Therefore, a trade-off is often required for their simultaneous achievement (see paragraphs [0005] and [0006] of the opposed patent).

Under these circumstances, and in view of the functional definition of the *desiderata*, the board considers it essential for the patent to contain sufficient and enabling information allowing the skilled person to carry out the invention and achieving the desired set of product characteristics without an undue burden of trial and error.

3.3 *The gaps of information*

3.3.1 In order to put the invention into practice, the appellants have identified the following alleged gaps of information:

- (a) the chemical composition of the undercoat layer;
- (b) the thickness of the silver layer;
- (c) the thickness of the intermediate layer;
- (d) the kind of metal oxide or nitride used for the overcoat layer;
- (e) the thickness of the overcoat layer;
- (f) the process parameters for sputtering an overcoat layer of a metal oxide or nitride having an index of refraction comprised in the interval of 1.85 - 2.25.

3.3.2 The appellants also criticized that the working examples of the patent were not reproducible and thus did not provide a suitable starting point for the skilled person trying to exploit the invention over the full width of the claims.

3.4 *Guidance in the description*

As to the various parameters enumerated in point 3.3.1 above, the description of the opposed patent provides in particular the following information:

- A preferred material for the undercoat layer is TiO₂. The thickness of the layer is 16 to 32 nm, preferably 20 to 30 nm [paragraph 0043]);
- The thickness of the silver layer is preferably 10 to 18 nm, more preferably 14 to 17 nm (paragraph

[0042]);

- A preferred material for the overcoat layer is SnO₂. The thickness of the layer is 35 to 70 nm, preferably 40 to 55 nm [paragraph 0044]);

- The overcoat layer is preferably made of TiO₂, having a thickness of preferably 0.5 to 1.5 nm, most preferably of 1.0 nm (paragraph [0046]);

- Typical process parameters (target composition, reactive and inert gas flows, pressure, cathode power, cathode voltage and current, line speed and number of passes) for sputtering the individual layers are indicated in connection with examples 1 and 2 (see Tables 1 and 2; Figures 1 and 2). According to paragraph [0048], the process and apparatus used to form the various layers are conventional and employ operating parameters well known to those of skill in the art.

3.5 *Instruction by way of examples*

3.5.1 The opposed patent contains also two working examples to illustrate the invention (see paragraphs [0049] to [0055], [0058] and [0059]).

Appellant 1 had argued already during the opposition procedure that the two working examples of the opposed patent represented in Figures 1 and 2 and described in paragraphs [0049] to [0055] could not be successfully repeated. In the appellant's view, it was in particular not possible to produce a sputter-coated glass article as per example 2 having a luminous transmittance of 89.11 % and a silver layer thickness as high as 16.5 nm. The appellant referred in this context to E7 (Figure 7) disclosing a maximum in luminous transmittance of only

83% at a silver layer thickness of 12 nm. Appellant 2 concurred with these arguments. However, in the contested decision (Reasons, point 21) the opposition division dismissed the appellant's objection on the grounds that the explanations based on E7 were inconclusive and that a faithful reworking of the examples had not been attempted.

3.5.2 Examples 1 and 2

The examples are discussed in more detail in the following (*cf.* also point 3.5.5., Table 1).

Example 1 (see paragraph [0049]):

soda-lime silica float glass (2 mm)
29 nm TiO₂, refraction index $n = 2.56$ (undercoat)
metallic Ag (16.5 nm)
1 nm TiO₂ (protective intermediate layer)
48 nm SnO₂ (overcoat)

The sputtering conditions for the various layers of example 1 are reported in Table 2 (page 9 of the patent in suit).

Properties of the coated glass (see paragraph [0055]):

T_{vis}: 87.15 %
E_n: 0.061
R_s: 4.87 ohm/sq
Color: substantially neutral

Example 2 (see paragraph [0050]):

soda-lime silica float glass (3.1 mm)
22.4 nm TiO₂, refraction index n = 2.56 (undercoat)
5.2 nm ZnO (barrier layer)
metallic Ag (16.5 nm)
1 nm TiO₂ (protective intermediate layer)
48 nm SnO₂ (overcoat)

The sputtering conditions for the various layers of example 2 are reported in Table 1 (page 7 of the patent in suit).

Properties of the coated glass (see paragraph [0053]):

T_{vis}: 89.11 %
E_n: 0.054
R_s: 4.80 ohm/sq
Color: substantially neutral

These experimental results, in particular the values for T_{vis}, E_n and R_s, fall within the scope of the independent claims.

3.5.3 Reproducibility

According to appellant 1, the examples 1 and 2 did not provide the skilled person with a reliable starting point for determining the necessary process parameters, because they could not be reproduced successfully. The appellant also strictly denied the possibility of obtaining - by standard sputtering techniques - a low-absorbing TiO₂ layer having a refractive index of as high as 2.56 at a wavelength of 550 nm. It was asserted

that any TiO_2 layers obtainable by sputtering inevitably had an increased light absorption and an increased extinction coefficient k , contrary to the requirement in the opposed patent according to which k should be less than 0.01 (see paragraph [0045]).

3.5.4 Re-working of the examples

In support of its assertions, appellant 1 filed a report comprising the sputter-coated glass samples V1 to V4, reproducing examples 1 and 2 of the opposed patent (see appeal brief, pages 9 to 14).

These test samples V1 to V4 were prepared on a laboratory-scale sputter-coating apparatus using a glass substrate ("Optifloat") of 2.1 mm thickness having a light transmittance of $T_L = \text{approx. } 90\%$, *i.e.* higher than of the glass used in example 2 of the opposed patent.

According to experiments V1 and V2, the TiO_2 layers were prepared by reactive sputtering from Ti targets, yielding TiO_2 having a refractive index of approximately only 2.45 (550 nm) and $k = 0.001$ (550 nm) (*i.e.* outside claim 1).

In accordance with experiments V3 and V4, the TiO_2 layers were prepared by non-reactive sputtering from Ti targets to obtain metallic Ti layers and subsequently oxidizing the metal at 500 °C in air, yielding TiO_2 layers having a refractive index of approximately 2.58 (550 nm) and $k = 0.001$ (550 nm). The optical properties of these TiO_2 layers thus corresponded to those of the opposed patent and also to the requirement of claim 1.

The layer thicknesses and the sputter conditions (except for TiO₂ in examples V3 and V4; see above) - save for minor experimental deviations - sufficiently matched those of examples 1 and 2 of the opposed patent (see the appeal brief of appellant 1, page 12, Table 3; for instance in V3: first TiO₂ layer having a thickness of 20.8 nm was produced compared with a nominal thickness of 22.4 nm). The board is satisfied that the deviations are within normal experimental margins of variation and sufficiently small to allow a meaningful comparison with the examples of the opposed patent.

3.5.5 Comparative results

The measured values of the optical properties of samples V1 to V4, in comparison with examples 1 and 2 of the opposed patent, are presented in the following Table 1:

Table 1

	T_{vis} %	R_G %	R_F %	R_S Ω / □	E_N
V1	78.4	15.9	13.1	2.4	0.031
V3	81.1	12.1	10.0	2.8	0.033
Example 1	89.11	5.3	4.28	4.8	0.054
V2	80.0	12.8	10.1	3.4	0.039
V4	81.4	9.5	7.2	3.4	0.036
Example 2	87.15	6.19	4.59	4.87	0.061

3.5.6 Comments on the comparative results

a) *Visible light transmittance T_{vis}*

It is evident that the transmissivity values T_{vis} of samples V1 to V4 are significantly inferior to those of the examples of the opposed patent. Similar significant discrepancies exist as regards the values for R_S and E_N . These differences are by far greater than one would expect from the small variances in the nominal thicknesses of the coating layers.

More importantly, the transmissivity values T_{vis} found in all examples V1 to V4 fall substantially below the claimed minimum value of 84%, irrespective of whether the refractive index n (550 nm) of the TiO_2 layer was low ($n= 2.45$ as in V1, V2) or high ($n= 2.58$ as in V3, V4). This suggested that the claimed invention could not be reproduced, no matter what the refractive index of the TiO_2 layers was.

The data demonstrated that the attempt of reproducing the examples of the opposed patent failed to achieve the high visible transparency values of at least 84% as set out in the claims, even though the glass substrate used by appellant 1 had been more light transmissive than the float glass used in the examples of the patent. Appellant 1 asserted that it was neither plausible *per se* nor derivable from the patent that coatings having a Ag layer thickness at the higher end of the patent's preferred range (10 to 18 nm) could yield the desired high visible transmittance. Rather, the literature at hand and the experimental evidence suggested that this was only possible with a Ag layer thickness of around 12 nm.

b) *Colour*

Appellant 1 and appellant 3 both argued that the neutral reflexion colour (*i.e.* colourless to slightly blue and non-purple) when viewed from the glass side, had also not been achieved by the examples of the opposed patent, as could be seen from the respective b_H -values of -8.79 and -8.44 (colour coordinates, III.C. Hunter).

3.6 Conclusions of the appellants

In summary, according to the appellants, the patent did not provide a solution to the underlying problem over the entire claimed range of thicknesses of 16 to 32 nm for the underlayer, but only over a very limited range of thicknesses, in combination with undisclosed limited thickness ranges for the silver layer. Even these limited combinations required special undisclosed selections of the material of the overcoat and of its thickness, in order to simultaneously achieve a high transmittance, a low emissivity and a neutral colour tone.

Appellants 1 and 3 therefore submitted that the requirement of Article 83 EPC was not met.

3.7 The respondent's position and the board's view

a) *Visible light transmittance T_{vis}*

The respondent argued that the failure of reproducing the high visible transmittance was possibly attributable to a high content of metallic Ti in the upper intermediate TiO_2 layer, causing high absorption.

Partial or full oxidation of the TiO_x layer sputtered in pure Ar atmosphere occurred only when the next layer was sputtered in a highly oxidizing atmosphere. However, the extent of oxidation of the TiO_x layer in appellant 1's examples was not known and might have been incomplete.

However, the board notes that it was undisputed that a partial oxidation of the TiO_x layer could be expected only if the thickness of the barrier layer was substantially greater than 1 nm. An incomplete oxidation can also be effectively ruled out in view of the observed transmission T_{vis} , absorption A_G and reflection R_F values (which add up to 100%). In examples V1 to V4, one observes A_G values higher than those of the opposed patent by only 0.1% to 3%, which differences are too small to explain the differences in T_{vis} of 6% to 11%. The board therefore accepts the assertion of appellant 1 that the TiO_2 layers of V1 to V4 were substantially fully oxidised, as required by the opposed patent.

b) *Silver layer thickness*

According to the respondent, it had not been disputed that the claimed invention worked with a thinner Ag layer of 12 nm. Under such circumstances, it was not plausible that the patentee should have included two non-working examples in the description which, due to their relatively high Ag layer thickness, would exhibit the desired high visible transmittance values.

The board cannot accept this argument because from the fact that the claimed invention worked with a thinner

Ag layer of 12 nm no conclusion can be drawn for higher Ag layer thicknesses. It is undisputed that thicker Ag layers make it increasingly difficult to maintain high visible transmittance. Therefore, the experimental failure of V1 to V4 is not at variance with a positive result at 12 nm. However, the patent's preferred range for the silver layer thickness is from 14 to 17 nm (see paragraph [0042]) and 16.5 nm in the examples; the patent in suit contains no working examples with a 12 nm Ag layer. The skilled person is therefore, in a first orientation, not directed by the patent at 12 nm, but at substantially higher silver layer thicknesses and thus bound to fail in the attempt to achieve the desired properties as defined in claim 1.

Another argument of the respondent was that the skilled person, having failed to achieve the desired high transmissivity of at least 84% following the examples 1 or 2, would have immediately realized that the thickness of the Ag layer should be reduced in order to overcome the problem. The skilled person would thus have been directed to embodiments having a substantially thinner Ag layer and higher transmission. The board disagrees because the thickness of the Ag layer is known to have a direct influence on the sheet resistance R_s and on the emissivity E_N . The patent itself states in paragraphs [0012] and [0013] that conventional coating systems having a thinner Ag layer in the range of from 5 to 15 nm may exhibit the desired high visible light transmittance (e.g. 85% to 86%) but suffer from high sheet resistance (e.g. about 6.7 to 8.2 ohms/sq) and a low level of IR reflection. Besides, such systems tend to exhibit a light purple coloration. Therefore, the skilled person would not have considered

- in the board's view - thinner Ag layers as a viable alternative.

c) *Computer simulation of examples 1 and 2*

Appellant 3 had filed under cover of a letter dated 6 October 2005 a document designated as "Annexe 4" and containing data obtained by a computer simulation of examples 1 and 2 of the opposed patent concerning the layer system glass/TiO₂/Ag/TiO₂/SnO₂ wherein the Ag layer thickness was 16.5 nm. Said simulation gave transmissivity values T_{vis} of 89.11% and 87.15%, respectively, in close agreement with the values given in the opposed patent and well above the 84% minimum value. In view of these positive results, the respondent argued that re-working the patent's examples 1 and 2 by appellant 1 (V1 to V4) was flawed and not conclusive.

However, as appellant 3 pointed out, the data of Annex 4 were not obtained experimentally, but as a result of a computer simulation of the claimed coating layer system. In the simulation programme, *inter alia* a refractive index of TiO₂ of 2.56 was used as input data, in accordance with the values given in examples 1 and 2 of the opposed patent. It was, however, disputed by appellant 3 and appellant 1 that TiO₂ layers having a refractive index n of 2.56 (550 nm) could be obtained by conventional sputtering (see points 3.6.8 d) and e) below). Therefore, the computer simulation results do not - in the board's view - conclusively prove that the claimed invention can be worked. In any event, the board considers that the experimental evidence, as submitted by appellant 1, carries a considerably

greater persuasive weight.

d) *Refractive index of the TiO₂ layer*

The respondent argued that experiments V1 and V2 had not been carried out according to the invention by appellant 1 because the refractive index of the TiO₂ layer was lower than required and because experiments V3 and V4 comprised a heat treatment for obtaining the TiO₂ layer.

These arguments are, although factually correct, in the board's opinion besides the point. Experiments V1 and V2 demonstrate that TiO₂ films having a refractive index of 2.56 (550 nm) could not be obtained by conventional sputtering, a fact which is also supported by E8 and E10 (see point 3.7 e), last paragraph). In an effort to nevertheless obtain such highly refractive TiO₂ films, and to produce a coated glass article having the structural features as claimed in claim 1 of the patent, an oxidizing heat treatment was carried out in experiments V3 and V4. Therefore, the deviations from the patent's teaching were only made in a fair attempt of reproducing the examples.

e) *Sputtering*

Contrary to appellant 1's assertion, documents E5, E6 and E8 proved that TiO₂ layers having a refractive index n between 2.2 and 2.8 could be obtained by RF magnetron sputtering.

In the board's view, these arguments were plausibly refuted by the appellants on the ground that E5, E6 and

E8 do not relate to conventional sputtering, but to high rate sputtering processes requiring special targets. According to the patent in suit (paragraph [0048]), however, the process and apparatus used to form the various layers on glass substrate is a conventional sputter-coating system using operating parameters well known to those of skill in the art.

E6 reports a number of refractive indices for TiO_2 in the range of from 2.488 to 2.9467, depending on the crystal modification, but does not concern layers of TiO_2 , but presumably bulk material. The document is moreover completely silent about the production of TiO_2 by sputtering.

E8 is about the preparation of TiO_2 film by RF magnetron sputtering. It is reported that the crystal structure of the films and hence the refractive index strongly depended on the substrate position and sputtering gas pressure. A refractive index of 2.44 to 2.67 was measured for 100% rutile films, whereas anatase films obtained under different sputtering conditions exhibited a lower index of from 2.25 to 2.47 (page 4955, point 4, "Conclusion"; E8, page 4952, left hand column, point 3.2; page 4952, Figure 5). The highly refractive rutile modification was obtained only under specific sputtering conditions. The opposed patent is however silent about such specific sputtering conditions.

E10 confirms that conventional magnetron sputtering of TiO_2 layers yields only a product having a lower refractive index of 2.4 to 2.45 (550 nm). A proprietary TwinMag[®] process using a mid-frequency (MF) double magnetron cathode is proposed in order to obtain TiO_2

films having a refractive index of 2.5 to 2.7 (550 nm). These TiO₂ films show higher light transmission, colour neutrality and a compact, smoother structure (see E10, page 203, "Abstract"; page 205, left hand column, points 2.4 and 2.5). Appellant 2 had correctly pointed out that it was known from E22 (published 1997) that sputtering of highly refractive TiO₂ had become commercially viable by the TwinMag[®] process of E10 and that it offered considerable advantages as a coating material in low-E glasses. These special deposition techniques are, however, neither explicitly nor implicitly disclosed in the opposed patent.

3.8 Lack of guidance

According to the respondent the invention was sufficiently disclosed in view of the clear guidance given in the description, paragraphs [0039] and seq., even if the examples could not be repeated or only with difficulties (which was denied).

The question to be answered by the board is whether there are gaps of information and whether they may be filled by the general common knowledge of the skilled person, without undue burden of trial and error. To this end, the board has to investigate whether the examples can be reproduced and whether they illustrate the invention and its desired effects, as claimed.

In view of the multitude of free parameters and the functional limitations characterizing the claimed invention (see point 3.2.2, item f)), without a proper starting point, preferably in the form of working examples, the board considers the guidance in the

description to be insufficient. It is from such examples illustrating the preferred embodiments of the invention that the skilled person generally sets out to explore the invention in its full ambit, as defined in the claims. However, in the present case, the examples are deficient in that they do not yield the desired results in terms of the functional claim feature f) defined under point 3.2.2.

Moreover, they are misleading in that they suggest that the invention can be carried out best with layer systems having a relatively high Ag layer thickness of 16.5 nm, whereas in fact such layer systems do not solve the problem posed.

In addition, the description is deficient and misleading in that the necessary highly refractive TiO₂ layers cannot, in fact, be obtained by standard sputtering methods. The tests V1 to V4 carried out by appellant 1 strongly suggest that even layer systems with TiO₂ layer having a high refractive index of approximately 2.58 (550 nm) do not generally (that is, in combination with other layers as per examples 1 and 2 of the opposed patent) solve the problem posed. The common general knowledge of the person skilled in the art does not help to fill the gaps of information and to cure the lack of guidance.

3.9 The board's conclusion

The board concludes that the subject-matter of claim 1 of the main request is not disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

No different or further arguments were brought forward by the respondent concerning auxiliary requests 1 to 4. In fact, claim 1 of all these requests contains the same functional features in terms of T_{vis} , R_s and E_n as claim 1 of the main request, so that the same problem of simultaneously achieving these desiderata arises. Claim 1 of the third auxiliary request in addition calls for a substantially neutral, non-purple colour and a non-mirror-like reflectance of the coated glass article, thus placing further constraints on the choice of the parameters.

Therefore, the arguments given above concerning claim 1 of the main request apply *mutatis mutandis* to the subject-matter of the claims of auxiliary requests 1 to 4.

The requirements of Article 83 EPC are therefore not met.

4. As no allowable request is on file, the opposed patent must be revoked.
5. Requests for remittal (Article 111(1) EPC) and apportionment of costs (Article 104 EPC)

The requests for a remittal and apportionment of costs (see the respondent's letter dated 26 April 2007, page 2, point 5) cannot be allowed.

A remittal of the case to the department of first instance would have doubtlessly caused a further, substantial delay in delivering a final verdict. In

view of the considerable amount of time the granting and opposition procedure have already taken (the priority date of the opposed patent goes back to the year 1997), a further delay is not in the interest of the public.

An apportionment of costs was requested only in connection with further oral proceedings before the first instance. As the case is not remitted, the point of apportioning such costs is moot.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The European patent is revoked.

The Registrar:

The Chairman:

B. Atienza Vivancos

G. Rath