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# Datasheet for the decision of 15 November 2006

**Case Number:** T 0218/02 - 3.3.05

**Application Number:** 97104710.5

**Publication Number:** 0796825

**IPC:** C03C 17/36

**Language of the proceedings:** EN

**Title of invention:**
A sputter coated glass article which is durable, of low emissivity and has a substantially neutral visible reflected colour, insulating glass units made therefrom, and methods of making same

**Patentee:**
Guardian Industries Corp.

**Opponent:**
01 Interpane Entwicklungs- und Beratungsgesellschaft
02 SAINT-GOBAIN GLASS FRANCE

**Headword:**
Sputter coated glass article/GUARDIAN

**Relevant legal provisions:**
EPC Art. 83, 54, 56, 113(1)
EPC R. 67

**Keyword:**
"Sufficiency of disclosure (yes)"
"Novelty (yes)"
"Inventive step (yes)"
"Substantial procedural violation"

**Decisions cited:**

**Catchword:**
-

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**Case Number:** T 0218/02 **-** 3.3.05

# D E C I S I O N
## of the Technical Board of Appeal 3.3.05
## of 15 November 2006

**Appellant:** (Opponent 1)
Interpane Entwicklungs- und
Beratungsgesellschaft mbH & Co.
Sohnreystraße 21
D-37697 Lauenförde (DE)

**Representative:**
Körfer, Thomas; Sartena, Christian
Mitscherlich & Partner
Patent- und Rechtsanwälte
Sonnenstraße 33
D-80331 München (DE)

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

**Representative:**
Hess, Peter K. G.; Mader, Joachim
Patent- und Rechtsanwälte
Bardehle, Pagenberg Dost
Altenburg Geissler
Galileiplatz 1
D-81679 München (DE)

**Party as of Right** (Opponent 2)
SAINT-GOBAIN GLASS FRANCE
18, avenue d'Alsace
F-92400 Courbevoie (FR)

**Representative:**
Jamet, Vincent; Muller, René
Saint-Gobain Recherche,
39, Quai Lucien Lefranc
F-93300 Aubervilliers (FR)

**Decision under appeal:** **Decision of the Opposition Division of the European Patent Office posted 19 February 2002 rejecting the opposition filed against European Patent No. 0796825 pursuant to Article 102(2) EPC.**

**Composition of the Board:**

**Chairman:** **M. Eberhard**
**Members:** E. Waeckerlin
S. Hoffmann

## Summary of Facts and Submissions

I. This appeal is from the decision of the opposition division to reject the oppositions by opponent 01 and opponent 02, respectively, against the European patent No. 0 796 825.

Independent claims 1 and 20, respectively, of the patent as granted read as follows:

*"1. A sputter-coated glass article comprised of a glass substrate having on a surface thereof, from the glass outwardly, a layer system including:*
*a) a layer of a transparent dielectric material having an index of refraction (n) of about 2.5 - 2.6 as measured at a wavelength of 550 nanometers;*
*b) a layer of $Si_3N_4$;*
*c) a layer of nichrome;*
*d) a layer of silver;*
*e) a layer of nichrome; and*
*f) a layer of $Si_3N_4$, and wherein*
*when said glass substrate has a thickness of about 2 mm - 6 mm, said coated glass substrate has a normal emissivity ($E_n$) of about 0.06 or less, a hemispherical emissivity ($E_h$) of about 0.07 or less, a sheet resistance ($R_s$) of about 5.0 ohms/sq. or less and having a substantially neutral visible reflected color when viewed from the glass side.*

*20. A method of sputter-coating a glass article of claim 1 wherein the undercoat layer (a) is sputter-coated in an oxygen-containing environment, the steps including controlling the oxygen content in said environment when sputter-coating said undercoat layer*

*(a) so as to obtain a sputter-coated undercoat layer (a) that has an index of refraction (n) of about 2.5 - 2.6 at a wavelength of 550 nanometers."*

II. During the opposition and appeal proceedings the parties relied ***inter alia*** on the following documents:

D1: EP-A-0 771 766

D3: S. Schiller et al.: *"Features of and in situ measurements on absorbing $TiO_x$ films produced by reactive D.C. magnetron-plasmatron sputtering"* Thin Solid Films 72, 1980, p. 475-483.

D4: US-A-5 376 455

D11: US-A-5 377 045

D13: EP-A-0 567 735

D15: EP-A-0 622 645

D16: WO 93/19936

D19: K. Okimura et al.: *"Preparation of rutile $TiO_2$ films by RF magnetron sputtering."* Jpn. J. Appl. Phys. Vol. 34, 1995, 4950-4955 (Part 1, No. 9A, September 1995).

D20: G. Bräuer et al.: *"New developments in high rate sputtering of dielectric materials."* Proc. of the 3rd ISSP, Tokyo, 1995, first page.

D22: AIRCO Coating Technology: Proceedings of the 2nd Coating Technology Symposium, Maui, Hawaii, 12-14 March 1990, pages viii and 11-1 to 11-12.

III. In its decision the opposition division held that the patent described the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

The claimed products were found to be novel in respect of document D1, because D1 did not disclose that the index of refraction (n) of the underlayer of the transparent dielectric material was about 2.5 to 2.6 at a wavelength of 550 nm.

The opposition division observed that there existed a consensus among the parties that either D13 or D15 represented the closest prior art, but in its view US-A-5 514 476 came much closer to the invention. The acknowledgment of this document in section [0021] of the patent in suit, and the appellant's comments in the next section, i.e. [0022], were held to be convincing. The combination of D13 and D15 could not have led the skilled person to the invention. The teaching of D15 was not to add an underlayer to the system, but to replace the bottom layer of silicon nitride in D13 by a layer of titanium dioxide. It could not be derived from the combination of the documents D15 and D13 how to proceed in order to arrive at the claimed subject-matter, which involved the use of an underlayer having a specific refraction index. The opposition division concluded that there was no evidence that the product of claim 1 was obvious. The same applied to all other claims referring back to claim 1, in particular

independent claim 20 relating to a process for manufacturing the sputter-coated glass article of claim 1.

IV. The appellant (opponent 01) lodged an appeal against the decision of the opposition division. He maintained his previous objections of insufficiency of disclosure, lack of novelty and lack of inventive step. He further requested the reimbursement of the appeal fee because of a violation of the right to be heard.

The party as of right (opponent 02, hereinafter "other party") submitted that the contents of the patent in suit were so contradictory that the skilled person did not have all information required to reproduce the invention.

Moreover the priority of the patent in suit was not valid. Therefore the coated article of claim 1 lacked novelty having regard to document D1, and there was also lack of inventive step in view of document D26.

D26: EP-A-0 717 014

V. The respondent (proprietor of the patent) submitted that the disclosure of the patent in suit was sufficient. Furthermore the claimed subject-matter was novel and involved an inventive step.

VI. Oral proceedings took place on 15 November 2006 in the presence of all three parties to the proceedings.

VII. The appellant submitted essentially the following arguments:

The features contained in claim 1 and relating to emissivities, sheet resistance and neutral colour described desired properties, but neither the claim nor the description provided a technical teaching which enabled the skilled person to obtain an article having all these features. Claim 1 did not specify the material of the dielectric layer (a), and there was no indication how the required properties of the glass article, viz. a refraction index of layer (a) in the range of 2.5 to 2.6 as well as the required emissivities $E_n$ and $E_h$, sheet resistance $R_s$, and neutral reflected colour, could be achieved. Although it was stated in the description that various dielectric materials including $TiO_2$, $Bi_2O_3$ and PbO or mixtures thereof were suitable, only $TiO_2$ was exemplified in any detail. According to the description the oxygen content in the sputter zone needed to be controlled carefully in order to obtain a $TiO_2$ layer having the desired refraction index. However there was a discrepancy between section [0074] of the description, which required a minimum of 49 % of oxygen, and the specific example, where the amount of oxygen was only 44 %.

Furthermore the appellant argued that the product of claim 1 lacked novelty in view of D1, because it was an inherent property of thin films of $TiO_2$ to possess a refraction index in the range of 2.5 to 2.6 at 550 nm.

The claimed product lacked an inventive step in view of D15, taken alone or in combination with D13.

Claim 20 had to be construed as relating to the step of sputter-coating the underlayer (a), not to the production of the glass article of claim 1 as such. Therefore the process of claim 20 lacked novelty in view of D11. In any case it was not inventive having regard to the combination of D3 and D11.

At the oral proceedings the appellant observed that claim 20, when construed as relating to a process for producing the article of claim 1, was not inventive having regard to the combination documents D15 and D3.

The appellant contended also that the opposition division had violated his right to be heard (Article 113(1) EPC), because the decision to reject the oppositions had been taken without giving him an opportunity to present his comments on the patentability of the process of claim 20 at the oral proceedings before the opposition division, although he had asked several times for it. This amounted to a substantial procedural violation. In the circumstances the reimbursement of the appeal fee under Rule 67 EPC appeared to be justified.

VIII. The other party submitted that the priority of the patent in suit was not valid. The priority document US 08/611 457 was a continuation in part of the earlier application US 08/552 366, which disclosed a "six layer system" that corresponded within the errors of measurement to the "specific example" of the patent in suit. Therefore the document US 08/611 457 did not constitute the first filing of the invention within the meaning of Article 4 C.(4) of the Paris Convention for the Protection of Industrial Property and Article 87

EPC. Consequently the subject-matter of claim 1 was not novel over the disclosure of D1.

Moreover the sputter-coated glass article of claim 1 was obvious in view of D26. It also lacked an inventive step in view of the teaching of D15, since it was known to the skilled person that silicon nitride is resistant to a thermal treatment.

The information given in the description of the patent in suit was ambiguous in respect of the ratio of oxygen to inert gas in the sputter coater zone for $TiO_2$. Therefore the disclosure was not sufficient for reproducing the invention.

IX. The appellant requested that the decision under appeal be set aside, that the European patent No. 0 796 825 be revoked, and that the appeal fee be reimbursed.

The other party requested that the decision under appeal be set aside and that the patent be revoked.

The respondent requested that the appeal be dismissed.

## Reasons for the Decision

1. In the notice of opposition opponent 02 has stated that the subject-matter of the patent in suit extended beyond the content of the application as filed (Article 100(c) EPC). This ground for opposition has not been substantiated, however, and the decision under appeal was not based on it. Consequently it does not

form part of the present appeal, so that there is no need to deal with the issue in the present decision.

2. *Validity of the priority*

2.1 The patent in suit claims the priority of US application serial N° 08/611457 filed on 22 March 1996. This application is a continuation-in-part of the earlier US application N° 08/552366, hereinafter D25, filed on 2 November 1995.

The other party argued that the example of a six layer system set out on page 37, line 20 to page 40, line 30 of D25 corresponded within the error margins to one of the "specific examples" set out in both the patent in suit (see pages 16 to 18, sections [0080] to [0084]) and the priority document US serial N° 08/611457 (see page 43, line 9 to page 46, line 4). Furthermore the invention of D25 was filed as a European patent application, namely D1, and D1 claimed the priority of D25. The other party concluded that the priority document US serial N° 08/611457 was not a first application within the meaning of Article 87(1) EPC and Article 4 C.(4) of the Paris Convention for the Protection of Industrial Property. The claimed priority was therefore not valid (see letter dated 9 November 2006, pages 1 to 3, in particular page 3, paragraph 6).

2.2 The board is of the opinion that the examples referred to by the other party are not identical. A comparison of these examples leads to the following result: The thicknesses of the various layers of the systems according to the examples are the same, except for the

first nichrome layer which has a thickness of 21 Å (2.1 nm) according to D25 (see page 39, line 7, layer b'), compared to 20 Å (2.0 nm) according to US serial N° 08/611457 (see page 44, line 8, layer b) and the patent in suit (see page 17, line 36, layer b), the difference of thickness being 5 %.

As far as the optical properties are concerned, the examples are substantially different. Thus, the reflectance $R_GY$ viewed from the glass side is 11.0 according to the example of D25 (see page 39, line 27), compared to 12,97 according to US serial N° 08/611457 (see page 45, line 3) and the patent in suit (see page 18, line 7), i.e. there is a difference of 17,9 %. The associated colour coordinates $a_h$ and $b_h$, respectively, are 2.3;-8.8 (see D25, page 39, lines 28-29), compared to 2.31;-5.98 (see US serial N° 08/611457, page 45, lines 4-5; patent in suit, page 18, lines 9-11), the difference of $b_h$ being 32,0 %. Large variations are also found in respect of the reflectance $R_fY$ seen from the film side (difference: 41,7 %) and the colour coordinates associated with visible transmittance $a_{h'}$ (difference: 32,2 %) and $b_{h'}$ (difference: 25,8 %) (see, in this respect, the comparative table submitted by the respondent at the oral proceedings). A further difference between the examples is the composition of the $Si_3N_4$-layers. According to D25 the targets used to form the layers contained an admixture of stainless steel (see page 37, lines 25-26), whereas no admixture of stainless steel is mentioned in the example of US serial N° 08/611457 and of the patent in suit.

2.3 Moreover the coating equipment employed to form the layer systems by sputter-coating, as well as the

coating conditions, were different. In the case of D25 an AIRCO ILS-1600 research coater was employed (see page 37, lines 20-21), whereas in the case of US serial N° 08/611457 and the patent in suit a five zone G-49 AIRCO coater was used (see priority document, page 43, lines 9-13; patent in suit, page 16, lines 53-56). The coater settings employed in the two cases were also very different, especially with regard to the parameters of pressure, flow rates of nitrogen, argon and oxygen, ratios of the various flow rates, cathode power, voltage and current (see D25, page 38, line 10 ff., Table "six layer system"; priority document, page 44, line 1 ff., Table "six layer system"; patent in suit, page 17, first Table).

2.4 A further difference between the examples lies in the fact that in the case of the example of D25 there is no indication of the index of refraction of the first layer of $TiO_2$, whereas both the priority document US serial N° 08/611457 and the patent in suit require the refraction index of the corresponding layer to be within the range of 2.5 - 2.6 at 550 nm.

2.5 The appellant and the other party have contended that the refractive index of thin layers of $TiO_2$ is inherently 2.5 at the reference wavelength of 550 nm. In support of their view they relied on document D15 relating to a thin film interference filter comprising ***inter alia*** a transparent substrate coated with a first substantially transparent dielectric layer. On page 5, lines 23-24 of D15 it is stated that ***"$TiO_2$ is particularly suited as the first dielectric layer since its index of refraction is 2.50 (550 nm)"***.

2.6 The board observes that, contrary to the argumentation put forward by the appellant and the other party, the refractive index (n) of thin layers of $TiO_2$, as measured at a wavelength of 550 nm, does not have a fixed value of 2.5, but is variable within wide limits. This follows, for example, from document D19 which relates to the preparation and the properties of sputter coated $TiO_2$-films. Depending on the pressure of the sputtering gas mixture during deposition on quartz substrates, various values of the refraction index (n) were found. Thus, it can be seen in Figure 5 that the values of the refraction index at the wavelength of 550 nm are substantially different for pressures of 2 mTorr, 6 mTorr and 20 mTorr, respectively, and are all clearly below 2.5 (see D19, page 4952, left hand colum, section 3.2 and Fig. 5).

Document D20 dealing with sputter coating of optical thin films on large glass substrates also contains information on the refractive index (n) at 550 nm of various materials for optical coatings. For $TiO_2$ a range of 2.35 to 2.55 is given (see D20, first page, Table 1). A further reference is document D16 according to which the refraction index of titanium oxide is variable within the range of 2.3 - 2.6, the most common value being 2.4 (see page 6, lines 5-6).

2.7 The other party has also referred to page 14, 2nd paragraph, of D25 in order to support his contention that D25 discloses the same invention as the patent in suit. The paragraph referred to contains a statement according to which by either admixing the layers of $Si_3N_4$ in the layer system with stainless steel ***"or optionally placing under these admixed layers an***

*undercoat layer of $TiO_2$, a still further, unexpected lowering of emissivity can be achieved."*

In this respect the board notes that, although the possibility of adding an underlayer of $TiO_2$ is mentioned in D25, the refractive index of such an underlayer is not addressed at all. For this reason the argument put forward by the other party cannot succeed.

2.8 For the reasons set out above the board concludes that the example contained in D25 does not relate to the same invention as the priority document US serial N° 08/611457 and the patent in suit. Therefore the claimed priority is valid.

2.9 In view of the validity of the priority, documents D1 and D26, respectively, are comprised in the state of the art according to Article 54(3) EPC, and thus have to be disregarded in the assessment of inventive step.

3. *Sufficiency of disclosure - Article 100b) EPC*

3.1 The appellant and the other party have raised a number of objections under Article 100 b) EPC against the patent in suit. Their arguments can be summarised as follows:

In claim 1 of the patent several parameters of the claimed product are stated, but there is no indication of how the required values of normal emissivity, hemispherical emissivity, sheet resistance and colour can be achieved. Claim 1 does not specify the chemical composition of the transparent dielectric material which is used for forming the first layer a) of the layer system. According to the description materials

such as, for example, $TiO_2$, $Bi_2O_3$, PbO or mixtures thereof may be used (see page 6, lines 12-14), but it is not disclosed how to obtain the required refraction index of 2.5 to 2.6, as measured at a wavelength of 550 nm. The indication in section [0074] on page 13 of the description that it is essential in the case of $TiO_2$ to control the ratio of oxygen to inert gas (e.g. argon) properly during the sputter-coating operation is of no help, because the respective data set out in the table on page 17 (see lines 5-14) are not in agreement with section [0074]. Thus, on the basis of the flow rates of oxygen (887 sccm) and argon (1127 sccm) set out for the targets 1-6 in the table, the ratio of $O_2$ to argon can be calculated to be 44 % : 56 %. Consequently, the amount of oxygen is below the limit of 49 % set out in section [0074] (see page 13, line 38).

In addition, while in claim 1 the features of normal emissivity, hemispherical emissivity, sheet resistance and reflected colour are related to a thickness of the glass substrate of 2 to 6 mm, the required values of these parameters are undefined in the case of glass substrates having a different thickness.

The appellant and the other party concluded that the patent in suit does not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

3.2 As to the first objection, the board observes that the description discloses in fact that various metal oxides are suitable as transparent dielectric materials (see also page 13, lines 24-26). The use of the preferred material, i.e. $TiO_2$, is described in detail by means of

the example set out in sections [0080] to [0084] on pages 16 to 18. There, the coating device, the number of coat zones and targets, the line speed as well as specific values of further operational parameters such as total and average power, average voltage, average current, flux rates of argon, oxygen and nitrogen, pressure, respective thicknesses of the layers, optical and electrical properties are given. Neither the appellant nor the other party has submitted that the skilled person was unable to reproduce this example, or that the product obtained by reproducing the example did not exhibit the properties as defined in claim 1 of the patent. In particular it was not contested that under the conditions of the example the index of refraction (n) of the $TiO_2$-layer, as measured at a wavelength of 550 nm, was in the range from 2.5 to 2.6.

3.3 The board is not convinced by the contention that there exists a discrepancy between the example and the information given in section [0074] of the patent in suit. Section [0074] states that a ratio of oxygen to argon of **preferably** (emphasis added) 49 % by volume of $O_2$ to 51 % by volume Ar (i.e. the lower limit) during a typical sputter-coating operation yields a $TiO_2$ having an index of refraction within the desired range of 2.5 to 2.6 (see page 13, lines 32-35). It appears that 49 % by volume of $O_2$ is the lower limit in the case of a power level of the coater apparatus of about 105 kW per tube (see page 13, lines 38-39). However, in the case of the example the average power was set differently, namely at 96.5 kW for the targets 1-6, the total power being 584 kW (see page 17, line 10, table).

3.4 Furthermore the board notes that the appellant and the other party have used the respective flow rates for calculating the ratio of oxygen (44 %) to argon (56 %). Yet, it is not proven that under the conditions of sputter-coating, i.e. operation under vacuum, the ratio of flow rates is equivalent to the volume ratio. The respondent has denied that such an equivalence exists, alleging that under operating conditions the oxygen and argon in the sputter chamber are far from being in a state of equilibrium. He explained that in the case of the example oxygen and argon were introduced into the sputter chamber at well defined flow rates by means of two pumps. The chamber was equipped with a gas outlet and a vacuum pump for removing the reaction gases. According to the respondent the efficiency of the vacuum pump was different for oxygen and argon, respectively. Therefore no equilibrium of the partial pressures of these two gases was reached during operation, even if the amounts of oxygen and argon supplied into the chamber were stable. As a result the ratio of flow rates did not correspond to the volume ratio of the gases.

The other party has expressed a dissenting opinion. In his view the arrangement of the various elements of the coater apparatus and the operating conditions are normally such that the coating is effected in a "stabilised mode", i.e. in a steady state with regard to the partial pressures of oxygen and argon in the sputter chamber. Under these circumstances the ratio of flow rates is equivalent to the volume ratio.

Taking into account the fact that the burden of proof rests on the appellant and the other party for their

allegation, which was contested by the respondent, that no evidence in support of this allegation was provided, and that the respondent's explanation appears to be plausible, the board cannot accept the allegation that under the conditions of sputter-coating the ratio of flow rates is equivalent to the volume ratio.

3.5 A further objection raised by the appellant, namely that in claim 1 the normal emissivity, hemispherical emissivity, sheet resistance and reflected colour are not defined for glass substrates having another thickness than 2 to 6 mm, has been presented for the first time during the oral proceedings. In the board's view it is not justified. Claim 1 defines the concerned optical properties for those thicknesses of the glass substrate that are commonly used in the applications envisaged by the patent. The board sees no reason why the skilled person should be unable, in view of the instructions in the description, to put the claimed subject-matter into practice when glass substrates having less common thicknesses (i.e. less than 2 mm or more than 6 mm) are used, and the appellant has not substantiated his objection in any detail in this respect. In any case, when thicknesses below 2 mm or above 6 mm are used, the optical properties of the layer system have to be measured using a substrate thickness of 2 to 6 mm.

4. *Novelty*

Claim 1

4.1 Document D1, is comprised in the state of the art under Article 54(3) EPC and, thus, is relevant for novelty

only. D1 discloses a sputter-coated glass article comprising a glass substrate having on a planar surface thereof, from the glass outwardly, a layer system including:
an undercoat layer of $TiO_2$; and
a) a layer of $Si_3N_4$ comprising 0.5 to 15 % of stainless steel by weight of the layer;
b) a layer of nickel or nichrome;
c) a layer of silver;
d) a layer of nickel or nichrome;
e) a layer of $Si_3N_4$ comprising 0.5 to 15 % of stainless steel by weight of the layer.

When the glass substrate has a thickness of 2 to 6 mm, the coated glass article exhibits a normal emissivity ($E_n$) of about 0.06 or less (e.g. 0.05 or less), a hemispherical emissivity ($E_h$) of about 0.07 or less (e.g. 0.06 or less), a sheet resistance ($R_s$) of about 5.0 Ohms/sq. or less and a substantially neutral visible reflected colour when viewed from the glass side (see D1, claims 1, 4 and 5; page 9, line 41 to page 10,line 30; Fig. 1A). A specific example of a six layer system is disclosed in D1 on page 15, line 37 to page 17, line 45. D1 indeed discloses a transparent dielectric undercoat layer of $TiO_2$, but it does not mention a refractive index within the range of 2.5 to 2.6, as measured at a wavelength of 550 nm.

4.2 The appellant has pointed out that in D1 the undercoat layer is consistently designated as a layer of "$TiO_2$" see page 5, lines 23, 44; page 9, line 43). In his view this means that D1 refers to the stoichiometric form of titanium oxide, but not to non-stoichiometric forms of $TiO_x$ (with $x \neq 2$). In view of the fact that D15 gives a

value of 2.50 for the refraction index of "$TiO_2$" as measured at 550 nm (see page 5, lines 23-24), he concluded that this applies likewise to the undercoat layer of D1.

Furthermore the appellant has argued that the skilled person, when putting the process disclosed in D1 into practice, would use a sputtering device as described, for example, in D22. The $TiO_2$-layer sputtered with such a known sputtering device had inevitably an index of refraction of 2.6 at the wavelength of 550 nm (see letter dated 10 December 2003, page 4, paragraph 3.2).

4.3 The board is not convinced by this argumentation for the following reason: Although it is stated in D15 that $TiO_2$ is the predominant form of titanium oxide created in the sputtering process, there is also the statement that ***"it is believed that other forms are produced as well. Thus, unless otherwise stated, $TiO_2$ will represent all forms of titanium oxide produced."*** (see page 5, lines 21-23). According to D20 the refraction index of "$TiO_2$" (at 550 nm) varies from 2.35 to 2.55 (see Table 1, last line). On the other hand, assuming for the sake of argument that D22 was available to the public before the priority date (see points 5.1 to 5.4 hereinafter), then D22 discloses that the values of the refraction index at 550 nm obtained in tests were 2.4 for $TiO_2$ and 2.60 for $TiO_x$ (see page 11-5, Table 2). Therefore the appellant's argument that the use of a sputtering device as described in D22 leads inevitably to an index of refraction of 2.6 at 550 nm is not convincing.

Document D3 on its part shows that the index of refraction of sputtered $TiO_x$ films, measured at the

wavelength of 467 nm, is a function of the partial pressure of oxygen during the sputtering process (see page 479, Fig.2, curve "refractive index"). Furthermore Figure 3(a) of D3 discloses that the index of refraction of $TiO_x$ films at a given wavelength, e.g. 550 nm, depends largely on the specific manufacturing conditions.

In view of these circumstances the board is of the opinion that the formula "$TiO_2$" as used in D1 cannot be equated with the stoichiometric form of titanium oxide, but unless otherwise stated includes all other forms produced during the sputtering process.

4.4 For the reasons set out above the sputter-coated glass article according to claim 1 of the patent in suit is novel having regard to D1.

4.5 The subject-matter of claim 1 is also new over the disclosure of the remaining documents cited by the parties. This was not disputed by the appellant and the other party. Therefore, no further considerations are necessary in this respect.

4.6 In view of the foregoing the board concludes that the sputter-coated glass article according to claim 1 of the patent in suit is novel.

*Claim 20*

4.7 According to the preamble of claim 20, said claim relates to a method of sputter-coating a glass article of claim 1. In the appellant's view this has to be understood as meaning that the method is suitable for

producing the product according to claim 1, but not restricted to the production of such a product. Therefore the appellant raised various objections of lack of novelty against claim 20 referring to the disclosure contained in document D11.

4.8 The appellant's argumentation is not convincing. It is plain from the wording of claim 20 that the claimed process inevitably results in the manufacture of the article of claim 1. This is in accordance with sections [0039] and [0040] of the patent in suit, and it has been expressly confirmed by the respondent at the oral proceedings. It was not disputed by the appellant that the sputter-coated glass article of claim 1 is new over the disclosure of D11. The said article differs from that of D11 in particular by the presence of both a first layer of a transparent dielectric material and, in addition, a layer of $Si_3N_4$ between the glass substrate and the first nichrome layer, and the first dielectric layer has an index of refraction of 2.5 to 2.6, as measured at 550 nm.

The sputter-coated glass article of claim 1 being new, the process of sputter-coating as defined in claim 20 and resulting in an article according to claim 1 is also novel over the disclosure of D11.

5. *Inventive step*

*Public availability of document D22*

5.1 During the appeal procedure the parties have expressed controversial views regarding the public accessibility of the disclosure contained in document D22. Both the

appellant and the other party contended that the information was open to the public, whereas the respondent argues that D22 was confidential and, thus, not comprised in the prior art.

5.2 Document D22 concerns the proceedings of a symposium on coating technology held on 12 to 14 March 1990 in Maui, Hawaii. It contains a twelve-page report on *"Durable Sputtered Low Emissivity Coatings"* by J. Wolfe and D. Dow from Airco Coating Technology (see page 11-1 ff.). Page viii of D22 bears the following note:

*"This document contains confidential or proprietary information of Airco Coating Technology. Neither the document not [sic] the information therein is to be reproduced, distributed, used or disclosed, either in whole or in part, except as specifically authorized by Airco Coating Technology, Technology Department, a division of the BOC Group, Inc."*

In the respondent's view the wording of this note makes it clear that document D22 is of a confidential nature and may not be made available to third parties. The respondent filed at the oral proceedings a letter dated 16 April 1990 from Airco Coating Technology to one of the participants of the symposium, Mr J-P. Beaufays, containing the following statements: *"Please find enclosed your copy of the proceedings of the Second Technology Symposium, hosted by Airco Coating Technology on March 12-14, at Maui, Hawaii"*, and:

*"You are being provided with a copy of the proceedings in accordance with your technology contract with Airco, which guarantees a forward flow of technical*

*information. This document is for your personal and corporate use; however, it is legally designated as confidential under the definition of our technology agreement, and the information contained therein must be treated as proprietary."*

5.3 In the opinion of the appellant and the other party the evidence presented by the respondent is not conclusive. At the oral proceedings the other party asserted ***inter alia*** that an employee of his own company, as well as one of the respondent's employees attended the symposium held on 12 to 14 March 1990. The participants did not have to sign an agreement of confidentiality, and in fact they did not sign such a document. Consequently the information provided at the symposium was public. The note on confidentiality appeared only later when the printed copy of the proceedings of the symposium were distributed to certain participants, including Mr. J-P. Beaufays. This presentation of facts was not contested by the respondent.

5.4 The board notes that the evidence presented by the parties is not sufficient for drawing a conclusion whether the disclosure contained in document D22 was confidential, or not. However, there is no need to investigate this issue further, because even if document D22 is taken into consideration for the purpose of assessing inventive step, this does not change the outcome of the decision.

***Claim 1***

5.5 The board agrees with the parties that the closest prior art is represented by document D15. This document

discloses a specific example of a sputter-coated glass article comprising a glass substrate and having on a surface thereof, from the glass outwardly, a layer system consisting of the following layers:

A) a layer of $TiO_2$ having an index of refraction (n) of 2.5 as measured at a wavelength of 550 nm;
B) a first layer of Ni-$CrN_x$;
C) a layer of silver;
D) a second layer of Ni-$CrN_x$;
E) a layer of $Si_3N_4$.
(see page 5, line 56 to page 6, line 23; page 6, Table 1; Figure 1; page 5, lines 23-24).

The five layers A) to E) were coated on a soda lime glass support having a thickness of 3 mm (see page 6, lines 21-22). The filter exhibited an emissivity of 0.10 (see page 6, Table 2, column "inventive filter").

5.6 According to section [0031] of the patent in suit the nichrome layer is preferably one in which at least a portion of the chromium is nitrided. The article of claim 1 of the patent in suit is thus distinguished from the specific example of D15 by a layer of $Si_3N_4$ between the layer of $TiO_2$ and the first nichrome layer. Moreover the emissivitiy is reduced ($E_n \leq 0.06$; $E_h \leq 0.07$, compared to 0.10 of the example of D15).

5.7 Starting from D15, the technical problem underlying the patent in suit can be seen in providing a sputter-coated glass article having good chemical and mechanical durability, a low sheet resistance, and a good balance of optical properties, in particular an improved emissivity, a substantially neutral visible

reflected colour when viewed from the glass side, and a good visible transmittance.

5.8 At the oral proceedings the appellant stated that the technical problem to be solved was to provide good optical properties, while making a practical realisation possible. This definition of the technical problem cannot be accepted, because it ignores ***inter alia*** the improvement of the emissivity achieved by the claimed layer system.

5.9 In view of the example set out in sections [0081] to [0084] of the patent in suit, it is credible in the absence of any evidence to the contrary that the technical problem has effectively been solved by the claimed article. This was not disputed by the appellant and the other party.

5.10 It remains to be investigated whether the prior art provided any pointers to the claimed solution.

5.11 The appellant has argued that D15 alone gave an incentive to develop the layer system further, thus arriving at the claimed invention. From the comparison of the "inventive filter", i.e. a system wherein the first dielectric layer was $TiO_2$, with the "comparative filter I", i.e. a system wherein the first dielectric layer was $Si_3N_4$ (see page 6, Table 2), the skilled person could recognise that $TiO_2$ offered better optical properties than $Si_3N_4$. Moreover $TiO_2$ was particularly suitable because it led to a better transmission than $Si_3N_4$ (see page 5, lines 23-25). On the other hand durability tests showed that the "comparative filter I" having a first dielectric layer consisting of $Si_3N_4$ was

better than the "inventive filter", where $Si_3N_4$ was replaced by $TiO_2$. Thus, so the appellant, the "comparative filter I" achieved better scores in the test evaluation in respect of "salt fog", NaOH, HCl, $H_2SO_4$ and "Taber" (see page 7, Table 3, second and last columns). The appellant submitted that, having regard to these findings, the skilled person would have maintained the entire layer system of the "comparative filter I", and would have added an additional layer of $TiO_2$ between the glass substrate and the first layer of $Si_3N_4$ to further improve the system.

5.12 The board is not convinced by this argumentation. Throughout D15, $TiO_2$ and $Si_3N_4$ are presented as suitable materials which may be used for the first dielectric layer (see page 3, lines 26 and 29; page 5, lines 23 and 26). Nowhere in D15 is there any indication that the two materials could be combined, so that the resulting layer system would comprise both a $TiO_2$ **and** a $Si_3N_4$-layer. Having regard to the durability tests relied upon by the appellant, the board notes that the "comparative filter I" indeed showed an improved durability compared to the "inventive filter" in respect of some specific tests, such as "salt fog", NaOH, and "Taber" However, the "inventive filter" differs from the "comparative filter I" not only by the $Si_3N_4$-layer being replaced by a $TiO_2$-layer, but also by the composition of the first and second precoat layers and the thickness of the various layers. D15 contains no information suggesting that the durability improvement can be attributed to the presence of the first $Si_3N_4$ dielectric layer. But even if the skilled person had concluded on the basis of the results contained in Table 3 (see page 7) that a layer of $Si_3N_4$

instead of $TiO_2$ led, indeed, to an improved durability of the system, he could not foresee that by either adding a layer of $Si_3N_4$ to the exemplified system of D15 or, alternatively, replacing part of the $TiO_2$-layer by a $Si_3N_4$-layer, he would arrive at a system having a good durability and, at the same time, a good balance of optical properties, in particular improved emissivity, a good visible transmittance, the desired reflected colour, and a low sheet resistance. For these reasons D15 alone does not lead to the claimed invention.

5.13 The appellant has further submitted that the claimed invention is obvious having regard to the combination of D15 with the teaching of D22. According to D22 each material should have a good sputter (deposition) rate if the layer is to be deposited with a reasonable number of cathodes at acceptable cycle times (see page 11-2, point 5). The deposition of silicon-based materials is possible with rates that are 4-5 times greater than $TiO_2$ with a C-MAG™ sputter source (see page 11-4, second paragraph, lines 1-2; see also page 11-5, Table 2, entries for $TiO_x$ and $Si_3N_4$, respectively). The appellant argued that, in view of the need to be able to produce the layers in a practical manner, D22 provided an incentive not to sputter the entire thickness of the $TiO_2$-layer of the system of D15, but to replace part of it by a layer of $Si_3N_4$ which could be sputtered much more efficiently.

5.14 The board is of the opinion that the above argumentation is based on hindsight. To find an efficient and practical manner for sputtering the layers was not the problem underlying the present invention. Nothing in D22 suggested that by using two

distinct dielectric layers of $TiO_2$ and $Si_3N_4$, respectively, a sputter-coated glass article having a low sheet resistance, a good balance of optical properties, in particular an improved emissivity, a good visible transmittance and the desired reflected colour, as well as a good durability, would be obtained.

5.15 Another argument put forward by the other party was that in a layer system of the type disclosed in D15 there existed the need to prevent the migration of oxygen from the titanium oxide layer into the silver layer. This could be achieved by providing two distinct dielectric layers of $TiO_2$ and $Si_3N_4$, respectively.

The board holds that this argument is also based on hindsight. Neither in D15 nor in the patent in suit the issue of preventing the migration of oxygen into the silver layer is addressed at all. Since it did not form part of the technical problem which had to be solved, any considerations regarding the migration of oxygen were irrelevant to the present invention.

5.16 During the oral proceedings the other party pointed out that the sputter-coated glass-articles of D15 had a major drawback, not mentioned in D15, namely that they did not resist the thermal treatment, because of diffusion of oxygen from the $TiO_2$-layer during the thermal treatment. Thus, in order to improve the thermal properties, a layer blocking the diffusion of oxygen into the silver layer was needed. Since the skilled person knew, for example from D4 (see claim 1; col. 19, lines 40-43), that layers of $Si_3N_4$ were heat-treatable, the good optical properties of $TiO_2$ could be

combined with resistance to heat-treatment by adding a layer of $Si_3N_4$.

Having regard to such considerations of thermal stability, the board observes that according to the patent in suit ***"in certain embodiments the layer systems are also heat treatable"*** (see page 6, line 20). It follows by implication from this statement that in other cases the layer systems are not heat treatable. In other words not all embodiments covered by claim 1 of the patent in suit are heat treatable. Therefore the aspect of heat treatment cannot be taken into consideration in the formulation of the technical problem. Moreover, when defining the technical problem to be solved, the other party did not consider all essential aspects of the technical problem, namely the need to achieve good chemical and mechanical durability, a low sheet resistance, a good balance of optical properties, a substantially neutral visible reflected colour, and a good visible transmittance. In these circumstances, the argumentation of the other party is not convincing and appears to be based on hindsight.

5.17 The appellant and the other party presented a further argumentation based on the combination of documents D15 and D13. They argued that document D13 disclosed ***inter alia*** a five-layered system comprising the sequence of layers $Si_3N_4$ / nichrome / silver / nichrome / $Si_3N_4$. Moreover D13 disclosed that further layers could, at times, include optical overcoats for further scratch resistance, or ***"undercoats for adhesive purposes and the like"*** (see page 4, lines 47-48). The appellant submitted at the oral proceedings that in view of the possibility of having further layers, the skilled

person would equip the sputtering device with only a small number of titanium targets for the formation of $TiO_2$ and employ silicon targets for the rest to form $Si_3N_4$. Such an approach was already imposed by the wish to increase the sputtering rate. The skilled person would thus arrive at the invention.

The board is not convinced by this argumentation. The reference in D13 to undercoats is unspecific. There is no disclosure of an undercoat consisting of $TiO_2$, let alone of the effects such a layer would have on the chemical and mechanical durability, the sheet resistance, the balance of optical properties, in particular the visible reflected colour, the visible transmittance and the emissivity of the coated layer system as a whole. Therefore D13 provided no pointer how the technical problem underlying the patent in suit could be solved.

5.18 The remaining published documents do not contain information which, in combination with the teaching of the preceding documents, would point towards the claimed article.

5.19 For all these reasons the sputter-coated glass article according to claim 1 of the patent in suit is considered to involve an inventive step as required by Articles 52(1) and 56 EPC.

*Claim 20*

5.20 The appellant argued that the process of claim 20 did not involve an inventive step having regard to the combination of documents D15 and D3. He submitted that

D3 disclosed how layers of $TiO_x$ having a specific index of refraction can be produced, namely by controlling the ratio $p_{O2}/p_{tot}$ of the Ar-$O_2$ gas mixture in the sputtering device.

5.21 Starting from D15, the technical problem underlying the claimed process can be seen in the provision of a process for manufacturing a sputter-coated glass article having good chemical and mechanical durability, a low sheet resistance, and a good balance of optical properties, in particular an improved emissivity, a substantially neutral visible reflected colour when viewed from the glass side, and a good visible transmittance.

5.22 Document D3 discloses in fact a method which allows the direct production of $TiO_x$ films with an O : Ti atomic ratio x of 0 - 2, and thus with variable refraction indices, by adjusting the ratio $p_{O2}/p_{tot}$ of oxygen to the total pressure of the Ar-$O_2$ gas mixture within the range of 0 to 0.23 (see page 475, "summary" and page 479, Figure 3(a)). However, D3 does not suggest adding a layer of $Si_3N_4$ to the system of the example of D15 or, alternatively, partially replacing the $TiO_2$-layer by a layer of $Si_3N_4$, in the expectation of solving the technical problem posed. For this reason the process of claim 20 cannot be regarded as being obvious having regard to the combination of D15 with D3.

5.23 Document D11 discloses a method for the production of a durable thin film interference filter on a transparent substrate, for example soda-lime silicate glass, by sputtering, said filter having a substantially neutral visible reflected colour. The following sequence of

layers is produced: (1) a first substantially transparent dielectric layer having an index of refraction within the range of 2.0 to 2.7, most preferably 2.4 to 2.7, comprising for example titanium oxide or silicon nitride, (2) a first metal precoat layer of, for example, a nickel-chromium alloy; (3) a partially reflective metal layer, for example a silver layer; (4) a second metal precoat layer, for example of the same material as layer (2); and (5) a second substantially transparent dielectric layer comprising silicon nitride (see claims 1, 2, 6 and 17; col. 2, line 48 - col. 3, line 2; col. 3, lines 47-63; col. 4, lines 5-10 and 14-21). The first dielectric layer containing $TiO_2$ was deposited by reactive sputtering using argon as the inert gas and oxygen as the reactant gas. The pressure and flow rate of the sputtering gases were controlled by conventional devices (see col. 6, lines 31-44). Neither D11 nor D3 contain information which would give the skilled person an incentive to produce **both** a layer of a transparent dielectric material having an index of refraction of about 2.5 to 2.6 at 550 nm **and** a layer of $Si_3N_4$ between the glass substrate and the first precoat layer of nichrome in order to solve the technical problem stated above. Therefore the claimed process is not obvious even in view of D11 and D3 taken in combination.

5.24 In any case, as claim 20 is to be understood as relating to a process for the manufacture of a sputter-coated glass article as defined in claim 1 of the patent in suit, the process of claim 20 derives its patentability from that of the claimed article.

6. *Novelty and inventive step of the further claims*

Claims 2 to 19 are dependent on Claim 1. Claims 21 and 22 are dependent on Claim 20.

Independent claims 23 and 26 to 31, respectively relate to insulating glass units comprising at least one sputter-coated sheet of glass according to one of the product claims 1, 4, 5, 9, 10, 13 or 19. Claims 24 and 25 are dependent on claim 23.

Independent Claim 32 relates to a method of making an insulating glass unit comprising the use of at least one sputter-coated glass article of Claim 3. Claims 33 and 34 are dependent on Claim 32.

Consequently the subject-matter of all these claims is also novel and inventive.

7. *Reimbursement of the appeal fee - Rule 67 EPC*

The appellant's request for reimbursement of the appeal fee must fail. According to Rule 67 EPC it is a precondition for reimbursement of the appeal fee that the board deems an appeal to be allowable. This condition is not fulfilled in the present case, since the appellant did not succeed with his request that the patent in suit be revoked. For this reason alone the request for reimbursement of the appeal fee has to be refused. In these circumstances the question whether or not a substantial procedural violation occurred need not be decided.

## Order

## For these reasons it is decided that:

1. The appeal is dismissed.

2. The appellant's request for reimbursement of the appeal fee is refused.

The Registrar: The Chairman:

C. Vodz M. Eberhard