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**Datasheet for the decision
of 14 April 2016**

Case Number: T 0920/12 - 3.3.05

Application Number: 03716744.2

Publication Number: 1506143

IPC: C03C17/34

Language of the proceedings: EN

Title of invention:

REFLECTIVE, SOLAR CONTROL COATED GLASS ARTICLE

Patent Proprietor:

Pilkington North America, Inc.

Opponent:

AGC Glass Europe

Headword:

Solar control coated glass article/PILKINGTON NORTH AMERICA,
INC.

Relevant legal provisions:

EPC Art. 54, 56

Keyword:

Novelty - main request (no) - auxiliary request (yes)
Inventive step - auxiliary request (yes)

Decisions cited:

G 0010/91, G 0001/95

Catchword:



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Case Number: T 0920/12 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 14 April 2016

Appellant: AGC Glass Europe
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted on 23 February 2012 rejecting the opposition filed against European patent No. 1506143 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman A. Haderlein
Members: H. Engl
P. Guntz

Summary of Facts and Submissions

I. European patent EP 1 506 143 B1 was granted with 33 claims, including two independent product claims. Subject-matter of the patent is a reflective, solar control coated glass substrate.

II. Claim 1 as granted reads:

"1. A coated glass substrate comprising:

a) a glass substrate;

b) a first coating deposited over the glass substrate, the first coating comprising a low emissivity layer having a thickness in the range of 1000 Å to 6000 Å and having a first refractive index in the visible spectrum; and

c) a second coating deposited over the first coating, the second coating comprising a visible light reflecting layer and having a second refractive index in the visible spectrum greater than the first refractive index of the first coating;

the coated glass substrate having an $R_f > 15\%$, $30\% \leq T_{vis} \leq 70\%$ and an emissivity less than or equal to about 0.3."

Claim 22 as granted reads:

"22. A coated glass article comprising:

a) a glass substrate;

b) a first coating comprised of fluorine doped tin deposited over the glass substrate, said first coating having a thickness in the range of 1000 Å to 6000 Å and having a first refractive index; and

c) a second coating comprised of an oxide of titanium deposited over the first coating; the second coating having a second refractive index

greater than the first refractive index of the first coating;

the coated glass article having an $R_f > 15\%$, $30\% \leq T_{vis} \leq 70\%$ and an emissivity less than or equal to about 0.3."

III. The opposition filed against the patent in suit was rejected by the opposition division and the patent was maintained as granted. This is the decision under appeal.

IV. The documents cited include the following:

D1: WO-A-99/48 828

D2: WO-A-98/34 883

D3: WO-A-00/37 373

D6: US-A-2002/0045073

D9: First Declaration of Mr E. Tixhon dated 24 April 2008

D17: "External Water Condensation and Angular Solar Absorptance", Uppsala Universiteit, 2007, ISBN: 978-91-554-6830-9

D21a: Declaration of Mr M. Soubeyrand

D23: US-A-4 952 423

V. The appellant's (opponent's) statement of grounds of appeal was filed with letter dated 20 April 2012. Enclosed were:

D22: Second Declaration of Mr E. Tixhon, dated 22 June 2012; and D23.

Further arguments were submitted with the appellant's letter dated 11 March 2016.

VI. The respondent (patentee) submitted its arguments with letter dated 29 October 2012. The respondent maintained the first, second and third auxiliary requests as filed with letter of 7 October 2011 and filed a new fourth auxiliary request.

VII. Claim 1 of the first auxiliary request reads (amendments with respect to claim 1 as granted in bold):

"1. A coated glass substrate comprising:

a) a glass substrate

b) a first coating deposited over the glass substrate, the first coating comprising a low emissivity layer **comprising fluorine doped tin oxide and** having a thickness in the range of 1000 Å to 6000 Å and having a first refractive index in the visible spectrum; and

c) a second coating deposited over the first coating, the second coating comprising a visible light reflecting layer and having a second refractive index in the visible spectrum greater than the first refractive index of the first coating;

the coated glass substrate having an $R_f > 15\%$, $30\% \leq T_{vis} \leq 70\%$ and an emissivity less than or equal to about 0.3."

Independent claim 20 reads:

"20. A coated glass article comprising:

a) a glass substrate;

b) a first coating comprised of fluorine doped tin oxide deposited over the glass substrate, said first coating having a thickness in the range of 1000 Å to 6000 Å and having a first refractive index; and

c) a second coating comprised of an oxide of

titanium deposited over the first coating;
the second coating having a second refractive index greater than the first refractive index of the first coating;
the coated glass article having an $R_f > 15\%$, $30\% \leq T_{vis} \leq 70\%$ and an emissivity less than or equal to about 0.3."

VIII. The board issued a communication dated 21 October 2015 including a preliminary opinion. Oral proceedings have been held on 14 April 2016.

IX. The appellant essentially argued as follows:

Regarding sufficiency:

The requirement of sufficiency of disclosure was not met.

Regarding novelty:

Document D1 already disclosed high-reflectance coated glass articles (examples 14, 15) having all the claimed features in combination, except for the emissivity values which were not explicitly disclosed. However, in the appellant's view an $\text{SnO}_2:\text{Sb}$ layer of around 4000 Å thickness with an Sb/Sn ratio of 0.05 inherently possessed an emissivity of about 0.23 (as evidenced by D9) and neither a TiO_2 overcoat nor an iridescence-suppressing SiO_x underlayer affected the emissivity of a low-E $\text{SnO}_2:\text{Sb}$ layer.

Consequently, examples 14 and 15 of D1 anticipated the subject-matter of claim 1 as granted.

Regarding inventive step:

D2 (example 2) or D3 (examples 30 or 41) represented the closest prior art. These documents related to solar control glasses having a colour-suppressing underlayer and a solar control layer of SnO₂:F.

Starting from D2 or D3, the problem underlying the opposed patent consisted in increasing the visible reflectance of a low-E coating.

To solve this problem, the skilled person would have considered applying an outer reflective layer of TiO₂ as taught in D1.

Alternatively, the appellant argued lack of inventive step over D6 in view of D1.

X. The respondent essentially argued as follows:

Regarding sufficiency:

No consent was given to the admission of ground of opposition of lack of sufficiency which was a fresh ground.

Regarding novelty:

It was accepted that the luminous reflectance measured for examples 14 and 15 in D1 was taken on the film side. However, claim 1 of the patent under appeal required the emissivity of the coated glass article (i.e. including the overcoat) to be 0.3 or less. This had not been shown. The respondent also contested that SnO₂:F and SnO₂:Sb layers were equivalent. A TiO₂ overcoat, applied according to D1, would increase the

emissivity of the coated articles by approximately 18% (D21a). The second declaration of Dr Tixhon (D22) contradicted the results found earlier in the Soubeyrand declaration D21a and also in D17, i.e. it was not plausible that a TiO₂ overcoat did not affect the emissivity of the coated article. Likewise, the iridescence-suppressing undercoat could also influence the overall emissivity of the coated article due to its effect on the structure of the low-emissivity layer.

The respondent criticised that the appellant had not presented data from the original samples according to D1 or on reworked samples produced by CVD on a float line, but on specimen where the overcoat was produced by sputtering.

Regarding inventive step:

It was only by hindsight that a skilled person could have combined selected teachings taken from D2/D3 and D1, essentially because antimony-doped and fluorine-doped tin oxide layers were not interchangeable as low-E layers.

D6 related to photoactive coatings formed by depositing, on a substrate 22, a stack 28 of Ti metal oxide layers on a film of zirconium oxide in the cubic phase. One of more optional functional coatings, such as a low-E layer, may be interposed between stack 28 and substrate 22. Starting from this prior art, which was clearly more removed from the opposed patent than D1, D2 or D3, it would have required a multitude of choices in order to obtain something falling under the scope of the claims.

XI. Requests

The appellant requested that the patent be revoked.

The respondent requested that the appeal be dismissed, or in the alternative, that the patent be maintained in amended form on the basis of the sets of claims filed with letter dated 7 October 2011 as first, second and third auxiliary requests, or on the basis of the claims filed with letter dated 29 October 2012 as a fourth auxiliary request.

Reasons for the Decision

1. Sufficiency of disclosure (Article 100(b) EPC)

This ground of opposition was not substantiated during the proceedings before the opposition division (see Annex to the summons for oral proceedings, the Minutes of the oral proceedings and the impugned decision, reasons 3). It is thus to be regarded as a fresh ground of opposition (G 10/91, OJ 1993, 420) and cannot be introduced into the appeal proceedings without the consent of the patentee (see G 1/95, OJ 1996, 615). Such consent was not given. The respondent's objection for lack of sufficiency of disclosure is therefore rejected as inadmissible.

2. Novelty

Main request

2.1 Document D1 discloses soda-lime float glass panels coated with a solar screening layer system comprising a pyrolytically deposited main layer containing oxides of

tin and antimony and a reflective overcoat of titanium oxide (see page 1, lines 22 to 24; page 3, lines 8 to 21 and 29, 30). Preferred embodiments further comprise a colour-neutralising underlayer between the substrate and the main coating, said underlayer including SiO_x and/or alumina (see page 4, lines 30 to 37). Inter alia the following specific examples are disclosed:

Example 14:

Glass / SiO_x [700 Å (= 70 nm)] / $\text{SnO}_2:\text{Sb}$ (Sb/Sn = 0.05; see page 8, lines 16 to 18, 28 to 33); 4136 Å = 414 nm] / pure TiO_2 [271 Å] $R_f = 18.3$ T_{vis} (or luminous transmittance) = 63.2%.

Example 15:

Glass / SiO_x [700 Å] / $\text{SnO}_2:\text{Sb}$; 3933 Å = 393 nm] / pure TiO_2 [452 Å] $R_f = 24.4$ $T_{\text{vis}} = 59.1\%$.

The respective emissivity values of these coated glass substrates are not explicitly disclosed in D1. However, according to the appellant, D9 showed that an $\text{SnO}_2:\text{Sb}$ low-E layer of around 400 nm thickness with an Sb/Sn ratio of 0.05 had an emissivity of about 0.23, i.e. clearly lower than the upper limit of 0.3 stated in claim 1 of the opposed patent. This was not disputed by the respondent. Furthermore, the second declaration by Dr Tixhon (D22) provided experimental evidence that applying a TiO_2 layer by sputtering or by CVD had no significant influence on the emissivity. Therefore, examples 14 and 15 of D1 anticipated, explicitly or implicitly, all the features of claim 1 of the patent as granted.

- 2.2 The respondent rebutted the appellant's novelty objection with the argument that the TiO_2 overcoat would have substantially increased the emissivity of

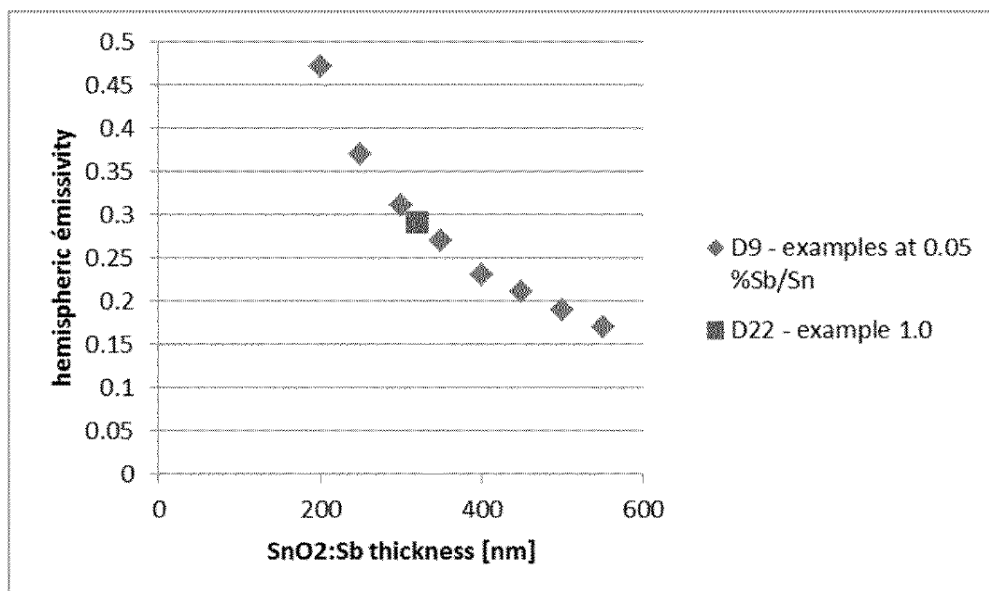
the low-E main layer. This was shown in the declaration by Dr Soubeyrand (D21a). Likewise, an iridescence-suppressing underlayer comprising SiO_x would also affect the emissivity of the stack. Therefore, one could not conclude with the required certainty whether the coated articles in accordance with examples 14 and 15 of D1 exhibited an emissivity of < 0.3 , as called for in claim 1 of the patent as granted.

The board does not find the respondent's arguments convincing in view of the arguments and evidence on file. According to the declaration D21a, a coated float glass specimen having a layer of about 25 nm SnO_2 on the glass, followed by about 25 nm SiO_2 and a low-E layer of 240 nm $\text{SnO}_2:\text{F}$ had an emissivity of 0.212. After modifying this stack by adding a top layer of about 41 nm of SiO_2 the emissivity was found to be higher by an amount of 18%. It was also stated that *"the TiO_2 overcoat applied according to the examples of D1 would have a similar effect on the emissivity of those coated articles"*. The board notes that D21a was filed by and in the name of the respondent and that Dr Soubeyrand, the author of the declaration D21a, appears to be an expert in the technical field of the patent in suit. The board accepts, in favour of the respondent, the factual correctness of the content of D21a.

Therefore, allowing for an 18% increase of the emissivity due to the TiO_2 overcoat, the hypothetical total emissivity of the coating system in D1 would be calculated as about $0.23 + 0.041 =$ about 0.27. Such an emissivity value still clearly falls under claim 1 as granted (less than or equal to about 0.3), by a substantial margin. The board thus concludes that the TiO_2 overcoat in the cited examples of D1 indeed affects the total emissivity but not to an extent that

the total emissivity would exceed the upper limit as called for in claim 1 as granted. Therefore, in the board's view, the first argument of the respondent fails.

The respondent's second argument, regarding the effect of the iridescence-suppressing underlayer comprising SiO_x , is also traversed by the evidence on file. The chart (see below) filed by the appellant in its letter dated 11 March 2016, page 5, comparing several examples of D9 (Sb/Sn ratio 0.05, thicknesses from 200 to 550 nm, no underlayer) with example 1.0 of D22 (Sb/Sn ratio 0.05, thickness of 320 nm, SiO_x underlayer) shows that the emissivity of the latter ($E_h = 0.29$) coincides with the graph comprising the emissivities traced out by the series of examples of D9. The conclusion is that the iridescence-suppressing SiO_x layer does not noticeably change (increase) the emissivity of the tin oxide layer doped with antimony.



In addition, the board refers to examples 2.0 and 4.0

of D22. For a SnO₂:F (ratio 0.05) low-E layer of 320 nm thickness, the same hemispheric emissivity E_h of 0.17 was obtained irrespective of whether an iridescence-suppressing layer was present (example 2.0) or absent (example 4.0).

The board therefore concludes that the effect of the iridescence-suppressing SiO_x layer on the total emissivity of a layer system of the type disclosed in examples 14 and 15 of D1 is insignificant.

Lastly, concerning the respondent's criticism that data presented by the appellant were not measured on original samples according to D1, or on reworked samples produced by CVD on a float line, but on specimen where the overcoat was produced by sputtering, the board considers that D22 provides plausible evidence that applying a TiO₂ layer by sputtering or by CVD has no significant influence on the emissivity.

Since the counter-arguments of the respondent cannot be accepted, the board finds for lack of novelty of the subject-matter of claim 1 as granted, having regard to D1.

The claim is therefore not allowable (Article 54 EPC) and the respondent's main request is rejected.

Auxiliary request 1

3. Amendments

Claim 1 is based on the original disclosure of claims 1, 5, 9, 10 and 11 and the description, page 6, lines 18 to 22. The remaining claims have not been amended. The board notes that the ground of opposition pursuant

to Article 100(c) EPC was not substantiated throughout the proceedings before the opposition division (cf. the reasons of the impugned decision).

The requirements of Article 123(2) and (3) EPC are thus met.

4. Novelty

As D1 fails to disclose a first coating consisting of a fluorine-doped tin oxide layer, the novelty of the subject matter of independent claims 1 and 20 of the first auxiliary request cannot be disputed.

D2 and D3 do not disclose a second coating layer, deposited over the first coating, of a transparent metal oxide having a refractive index greater than the refractive index of the first coating (e.g. TiO_2), said second layer increasing the visible light reflectance of the coated glass substrate. Therefore, the claimed subject-matter is novel also having regard to D2 and D3.

The appellant did not maintain novelty objections based on other documents and raised in the proceedings before the opposition division. The board is also satisfied that none of the available prior art documents discloses all the features of claims 1 or 20 of the first auxiliary request in combination.

The requirements of Article 54 EPC are thus met.

5. Inventive step

5.1 The patent in suit concerns reflective solar control coated glass substrates.

5.2 Closest prior art

The appellant considered D2 or D3 to represent the closest prior art which was not contested by the respondent. D2 discloses high-performance solar control neutral colour tinted glass panes, assembled as double glazing units. The tinted glass panes carry a pyrolytic IR-reflecting fluorine-doped tin oxide coating and a color-suppressing underlayer. The normal emissivity E_n of the stack is 0.16 (see D2, page 7, lines 1 to 5; Table 1a, example 2).

D3 discloses, in preferred embodiments, glasses coated with a pyrolytic coating of tin and antimony in a molar ratio of Sn/Sb of between 0.04 and 0.16 and a thickness of 250 to 500 nm, the emissivity of such a layer system being less than 0.3 (see page 3, lines 27 to 36; page 7, lines 1 to 3, 11 to 15, 22 to 31). As an alternative, the low emissivity layer may also be based on fluorine-doped tin oxide (page 7, lines 3 and 4, examples 30 and 41). Optionally a haze-preventing underlayer of about 100 nm silicon oxide may be present (see D3, page 7, lines 11 to 15; cf. Table 11, examples 30 and 41).

In view of the close structural similarity of the coated glasses in accordance with D2 and D3, which differ from the subject-matter of claim 1 of auxiliary request 1 only by the absence of a further coating overlying the low-emissivity layer, and in view of the similar technical fields of D2 and D3 (solar control

coated glass), the board is satisfied that each of these documents may indeed be taken as the closest prior art.

The appellant also argued in writing that D6 could be taken as representing the closest prior art as it disclosed low-E coatings with a preferred emissivity of less than 0.2 (page 4, column 1, lines 5 to 7) and a TiO₂ overcoat. D6 (page 4, column 1, line 7) referred to D23 (see examples 1 to 5) for functional low-emissivity CVD coatings having an emissivity of less than 0.4. Therefore, D6 also disclosed stacks of glass having a functional coating of fluorine-doped tin oxide, for example GL/SnO₂:F(200 nm)/TiO₂(10-50nm, preferably > 20 nm), having an emissivity of 0.19 to 0.20 and an Rf value in the claimed range.

The board cannot follow this approach. The board is not convinced that D6 is of interest for the skilled person in view of the objective and purpose set out in the patent in suit, as D6 is mainly concerned with photoactive coatings formed by depositing TiO₂ on a film of cubic zirconium oxide. The low-E coatings are only optional (see D6, claims 1 to 4 and 11; paragraph [0031]).

As already pointed out convincingly by the opposition division in the contested decision (point 9), starting from D6 a series of crucial and non-obvious selections would be required to arrive at a coating system falling under the scope of claim 1. Firstly, selecting titanium dioxide as the outer photocatalytic layer 32, secondly, selecting a low-E coating from among the list of functional coatings (38) as disclosed in paragraph [0031] as the inner layer (30), thirdly selecting fluorine-doped tin oxide as the low-E coating, and

lastly, adapting the selected combination in such a way that the resultant coating system exhibited the properties of the coated article defined in claim 1 of the first auxiliary request. There is no motivation or guidance in D6 or elsewhere for such an exercise, in view of the objective and purpose set out in the patent in suit.

The board therefore starts from either D2 or D3 as the closest prior art.

5.3 Technical problem of the patent in suit

The problem underlying the opposed patent consists in increasing the visible light reflectance of a glass article having a low-emissivity coating layer (see patent in suit, paragraphs [0005] to [0007] and [0016]).

5.4 Solution

As a solution for the above defined technical problem, the opposed patent proposes a coated glass substrate in accordance with claim 1 of the first auxiliary request, characterized by a second coating comprising a visible light reflecting layer and having a second refractive index in the visible spectrum greater than the first refractive index of the first coating, such that the coated glass substrate has an $R_f > 15\%$ and $30\% \leq T_{vis} \leq 70\%$ and an emissivity less than or equal to about 0.3.

5.5 Success of the solution

It was not disputed that the above defined problem was successfully solved, and the board agrees with this

view.

5.6 Obviousness

It remains to be decided whether the proposed solution is obvious having regard to the prior art.

- 5.6.1 Document D1 is concerned with transparent coated glass substrates with high reflectance, for use as exterior glazing panels for buildings (page 1, lines 1 to 4). Disclosed are in particular reflective overcoats having a thickness of 30 to 150 nm and a refractive index of 2.0 to 2.8, which are deposited on a pyrolytically-formed low-E layer of tin and antimony oxides (page 3, lines 8 to 14). The reflective layer, preferably comprising titanium oxide, gives a high luminous reflectance RL for a very thin coating thickness (page 3, lines 29 to 32). D1 reveals that *"the presence of an outer reflective layer [of 30 to 150 nm thickness and a refractive index of 2.0 to 2.8] created an improvement in the luminous reflectance of the coated substrate, increasing the reflectance (...) generally to at least 15% and even to around 25% (...) without taking the other optical properties of the substrate beyond acceptable limits"* (page 3, lines 15 to 20).

According to the appellant, it would have been obvious to solve the problem underlying the patent in suit by providing the coated glass substrate having the coatings disclosed in D2 (example 2) or D3 (examples 30 and 41) with an additional outer reflective layer as taught in D1. In the appellant's view, even if there were some differences between an SnO₂:F coating (as used in D2, D3) and a SnO₂:Sb coating (as used in D1), their respective refractive indices n in the visible range were practically identical at a low doping level

of $S_n = 0.05$. For the visible light reflectance, these coatings were almost identical. Such minor differences would not have deterred the skilled person from applying a reflective coating over a fluorine-doped tin oxide low-emissivity layer.

- 5.6.2 In the opinion of the board, the appellant's chain of reasoning is based, at least partly, on hindsight, for the following reasons.

Low-emissivity layers of antimony-doped tin oxide and fluorine-doped tin oxide may be considered as alternative materials for forming low-emissivity layers (see D3, page 7, lines 2 to 4), but they do differ in some important properties, such as absorption. This was admitted by the appellant (see statement of grounds of appeal, page 7, point Va, last paragraph).

Furthermore, the examples of D2 and D3 selected by the appellant as the closest prior art cannot be taken as representative for the key teachings of said documents. D2 primarily aims at improving light transmittance, not reflectance or emissivity (see page 1, lines 14 to 22; examples 1 to 4; claim 1). The objective of D3 is to provide a glass glazing having a high level of solar protection combined with high selectivity (defined as the ratio between light transmission factor LT and energy transmission factor ET) and having low light reflection (see D3, page 2, line 13 to 19, 27 to 29 and page 8, lines 7 to 10). Examples 30 and 41 of D3, which are the only examples having a fluorine-doped low-emissivity layer, are not preferred with respect to selectivity (example 30: $LT/ET = 1.89$, to be compared with example 28 (2.00) and example 29 (2.0); example 41: $LT/ET = 1.41$, to be compared with example 39 (1.68) and example 40 (1.81)). Moreover, the light reflection

factor LR is significantly lower in the examples according to the invention of D3 compared to the comparative examples (see Tables 2 to 10).

The board thus notes that the problem to be solved (see at 5.3 above), i.e. increasing the visible light reflectance, is to some extent opposed to the teachings of D2 and D3 including improving light transmittance or having a low light reflection factor.

It must also be considered that D1 teaches away from using fluorine in the coatings as fluorine is said to interfere with the incorporation of certain elements such as Sb into the coating layers (see D1, page 5, lines 14 to 16). In view of this statement the skilled person would be discouraged to apply the teachings of D1 to those examples in D3 which have a fluorine-doped tin oxide layer. The same holds true for the examples of D2 which also comprise a fluorine-doped tin oxide layer.

5.6.3 In conclusion, the subject-matter of claim 1 of the first auxiliary request is not obvious in view of the cited prior art.

The same conclusion applies to claim 20, which recites all the essential elements of claim 1, and to the dependent claims.

5.7 As the first auxiliary request is allowable, there is no need to deal with the lower-ranking requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to maintain the patent on the basis of claims 1 to 30 of the first auxiliary request, filed with letter dated 7 October 2011, and a description and figures adapted thereto.

The Registrar:

The Chairman:



C. Vodz

A. Haderlein

Decision electronically authenticated