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(54) Title: IN-MOULD COATING OF POLYCARBONATE PANELS

(57) Abstract: Methods for in-mould coating of polycarbonate plastic materials and products produced therewith, especially for use with automotive applications such as but not limited to windshields, windows (e.g., side windows, rear windows, and/or the like), taillight covers, headlight covers and the like. The coating is applied to the polycarbonate plastic material when the polycarbonate plastic material is disposed in a mold. The coating can be injected, sprayed or otherwise applied onto the polycarbonate plastic material. The coating can include any number of materials, including but not limited to hard coat materials. The coating can be partially cured while the product is in the mold, and then later fully cured, e.g., by thermal or UV energy. The products can include multiple layers of polycarbonate plastic materials, as well as other materials, and can be produced in any number of ways, including but not limited to injection molding, compression molding, and/or the like.



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IN-MOULD COATING OF POLYCARBONATE PANELS

FIELD OF THE INVENTION

[0001] The present invention relates generally to polycarbonate plastic materials and more specifically to methods for in-mould coating of polycarbonate plastic materials and products produced therewith, especially for use with automotive applications such as but not limited to windshields, windows (e.g., side windows, rear windows and/or the like), taillight covers, headlight covers and the like.

BACKGROUND OF THE INVENTION

[0002] Automotive windows, by and large, have heretofore generally been made from glass. Recently, automotive manufacturers have been exploring the feasibility of using polycarbonate plastic materials, which are much lighter than glass, to manufacture automotive windows. An example of polycarbonate plastic material technology can be found with reference to U.S. Patent No. 6,365,277 to Wilson, the entire specification of which is expressly incorporated herein by reference.

[0003] While the use of polycarbonate plastic materials has been acceptable for certain applications, such as for commercial bus windows, their lack of durability has precluded polycarbonate materials from widespread use in passenger cars. In particular, conventional polycarbonate plastic material is subject to scuffing and marring during manufacture and at the point of use, as well as requiring protection from UV light. Conventional efforts to place a protective hard coat layer on the polycarbonate plastic materials are relatively complex, time consuming, and expensive.

[0004] Accordingly, there exists a need for new and improved methods for producing and coating polycarbonate plastic materials as well as products produced therewith, especially for use with automotive applications such as but not limited to windows (e.g., side windows, rear windows and/or the like), windshields, taillight covers, headlight covers, and the like.

SUMMARY OF THE INVENTION

[0005] It is an object of the present invention to provide a new and improved method for producing a coated polycarbonate plastic material which obviates at least one disadvantage of the prior art.

[0006] It is an object of the present invention to provide a new and improved method for in-mould coating of a polycarbonate plastic material.

[0007] It is an object of the present invention to provide a new and improved method for producing a coated polycarbonate plastic material for use with automotive applications such as but not limited to windows (e.g., side windows, rear windows and/or the like), windshields, taillight covers, headlight covers, and the like.

[0008] It is an object of the present invention to provide a new and improved coated polycarbonate plastic material.

[0009] It is an object of the present invention to provide a new and improved in-mould coated polycarbonate plastic material.

[0010] It is an object of the present invention to provide a new and improved coated polycarbonate plastic material for use with automotive applications such as but not limited to windows (e.g., side windows, rear windows and/or the like), windshields, taillight covers, headlight covers, and the like.

[0011] In accordance with a first embodiment of the present invention, a method for producing a polycarbonate plastic material having a hard coat layer applied to a surface thereof is provided, wherein the hard coat layer is applied by a process selected from the group consisting of spraying, injection molding, compression molding, and combinations thereof.

[0012] In accordance with a second embodiment of the present invention, a method for producing a polycarbonate plastic material having a partially cured hard coat layer applied to a surface thereof is provided, wherein the partially cured hard coat layer is applied by a process selected from the group consisting of spraying, injection molding, compression molding, and combinations thereof.

[0013] In accordance with a third embodiment of the present invention, a method for producing a polycarbonate plastic material having a fully cured hard coat layer applied to a surface thereof is provided, wherein the fully cured hard coat layer is applied by a process selected from the group consisting of spraying, injection molding, compression molding, and combinations thereof.

[0014] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0016] Figure 1 is a perspective view of an automobile containing several products comprised of the coated polycarbonate plastic materials produced in accordance with the general teachings of the present invention, in accordance with a first embodiment of the present invention;

[0017] Figure 2 is a schematic view of an injection molding machine operable to form products from the coated multilayer polycarbonate plastic materials of the present invention, in accordance with a second embodiment of the present invention;

[0018] Figure 3 is a partial sectional view of a coated polycarbonate plastic material produced in accordance with the general teachings of the present invention, in accordance with a third embodiment of the present invention;

[0019] Figure 3a is a partial sectional view of an alternative version of the coated polycarbonate plastic material depicted in Fig. 3, in accordance with a fourth embodiment of the present invention;

[0020] Figure 4 is a partial sectional view of a coated multilayer polycarbonate plastic material produced in accordance with the general teachings of the present invention, in accordance with a fifth embodiment of the present invention; and

[0021] Figure 4a is a partial sectional view of an alternative version of the coated multilayer polycarbonate plastic material depicted in Fig. 4, in accordance with a sixth embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] The following description of the preferred embodiment(s) is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0023] Referring to Fig. 1 there is shown a perspective view of an automobile 10 containing several products comprised of the coated polycarbonate plastic materials of the present invention, in accordance with one embodiment of the present invention. More specifically, the coated polycarbonate plastic materials of the present invention can be formed and/or incorporated into a front windshield 12, side window 14, vent window 16, rear windshield 18, headlight cover 20, taillight cover 22, and/or the like. It should be appreciated that the coated polycarbonate plastic materials of the present invention can be employed in non-automotive applications as well. Accordingly, the coated polycarbonate plastic materials of the present invention can be used in practically any application that would also be suitable for conventional glass materials.

[0024] Referring to Fig. 2, there is shown a schematic view of an injection molding machine 100 operable to form products from the coated multilayer polycarbonate plastic materials of the present invention, in accordance with a second embodiment of the present invention. The injection molding machine 100 preferably includes an injection system 102, hydraulic system 104, mold system 106, clamping system 108, control system 110, and/or the like. In accordance with a preferred embodiment of the present invention, the injection molding machine 100 is operable to operate under low stress conditions (e.g., such as those used in coining processes).

[0025] The mold system 106 preferably includes a stationary platen member 112 and a selectively movable platen member 114 with a cavity 116 formed therebetween. In the injection molding process of the present invention, the polycarbonate material is preferably introduced into the injection system 102 (e.g., through a hopper), preheated to a sufficient degree, and introduced (e.g., via the action of a screw actuated by the hydraulic system 104) through a nozzle, sprue or similar device into the cavity 116 between the two platen members 112, 114, respectively, of the mold system 106. The movable platen member 114 is brought into contact with the heated polycarbonate material for a sufficient period of time and

under a sufficient amount of pressure so as to form a product, such as but not limited to the products described in Fig. 1. Additionally, one or more additional layers of polycarbonate material, or any other type of material, can be disposed onto the original layer of the polycarbonate product so as to form a multilayer polycarbonate product, similar to the product shown in Fig. 4. By way of a non-limiting example, one of the polycarbonate layers could be provided with a pigment dispersed therein to provide for a colored polycarbonate panel, such as those suitable for taillights and/or tinted windows. This can be accomplished by employing one or more selectively operable (e.g., rotatable) movable platen members that can be used to form each respective polycarbonate layer.

[0026] In order to coat the polycarbonate product while the product is still in the mold system 106, a coating system 118 is provided wherein a coating material can be injected, sprayed or otherwise applied onto at least a portion of the polycarbonate product so as to form a coated polycarbonate product, such as those shown in Figs. 3 and/or 4. The coating system 118 can cooperate with the mold system 106 so that the coating material can be injected directly onto the polycarbonate layer. Alternatively, the mold system 106 can be opened and the coating material can be sprayed onto the polycarbonate layer, e.g., the coating system 118 can be located outside of the injection molding machine 100.

[0027] Once the coating material is applied, it is preferably allowed to at least partially cure such that the surface of the coating material is not tacky to the touch. Once the coating material has at least partially cured, the coated polycarbonate product can be removed from the mold system 106 and either shipped or further processed, e.g., fully cured by thermal and/or UV curing methods.

[0028] Referring to Fig. 3, there is shown a partial sectional view of a coated polycarbonate plastic material 200 produced in accordance with the general teachings of the present invention, in accordance with a third embodiment of the present invention. The coated polycarbonate plastic material 200 is preferably comprised of a polycarbonate layer 202 and a coating layer 204 disposed on at least a portion of a surface thereof.

[0029] In accordance with an alternative embodiment, both surfaces of the polycarbonate layer 250 could be provided with a coating layer 252, 254,

respectively to form a double coated polycarbonate plastic material 256, as shown in Fig. 3a, in accordance with a fourth embodiment of the present invention.

[0030] Referring to Figs. 3-3a, the respective coating layers can be comprised of any number of suitable materials, but are preferably operable to protect the respective underlying polycarbonate layer from physical and/or chemical damage. By way of a non-limiting example, the respective coating layers are preferably comprised of a hard coat material such as, but not limited to, acrylic and/or acrylic-based materials. The coated polycarbonate plastic material 200 can be shaped into any number of configurations, including those described in Fig. 1. Additionally, the respective polycarbonate plastic material can be formed into any number of ways, including but not limited to spraying, injection molding, compression molding, and/or the like, as previously described.

[0031] Referring to Fig. 4, there is shown a partial sectional view of a coated multilayer polycarbonate plastic material 300 produced in accordance with the general teachings of the present invention, in accordance with a fifth embodiment of the present invention. The coated multilayer polycarbonate plastic material 300 is preferably comprised of a first polycarbonate layer 302, a second polycarbonate layer 304 (or other desired material), and a coating layer 306 disposed on at least a portion of one or both of the polycarbonate layers 302, 304, respectively.

[0032] In accordance with an alternative embodiment, both surfaces of the polycarbonate layers 350, 352, respectively, can be provided with a coating layer 354, 356, respectively, to form a double coated polycarbonate plastic material 358, as shown in Fig. 4a, in accordance with a sixth embodiment of the present invention.

[0033] Referring to Figs. 4-4a, the respective coating layers can be comprised of any number of suitable materials, but are preferably operable to protect either or both of the respective underlying polycarbonate layers from physical and/or chemical damage. By way of a non-limiting example, the respective coating layers are preferably comprised of a hard coat material such as but not limited to acrylic and/or acrylic-based materials. The respective coated multilayer polycarbonate plastic materials can be shaped into any number of configurations, including those described in Fig. 1. Additionally, the respective coated multilayer polycarbonate plastic materials can be formed into any number of ways, including but not limited to

spraying, injection molding, compression molding, and/or the like, as previously described.

[0034] The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

CLAIMS

What is claimed is:

Claim 1. A method for producing a polycarbonate plastic material comprising the steps of:

providing a polycarbonate plastic layer;

providing a hard coat layer; and

applying said hard coat layer to the surface of said polycarbonate layer by a process selected from the group comprising spraying, injection molding, compression molding and combinations thereof.

Claim 2. The method of claim 1 wherein said hard coat layer is applied to the polycarbonate plastic layer while the polycarbonate plastic material is disposed in a mold.

Claim 3. The method of claim 1 further comprising providing a second polycarbonate plastic layer adjacent to said first polycarbonate plastic layer.

Claim 4. The method of claim 3 further comprising providing a second hard coat layer adjacent the second polycarbonate plastic layer.

Claim 5. The method of claim 4 wherein said second polycarbonate plastic layer and said second hard coat layer are overmolded either in the same mold or using rotary platens.

Claim 6. The method of claim 1 further comprising the step of producing a finished product having a polycarbonate layer and a hard coat layer.

Claim 7. The method of claim 6 wherein said finished part is selected from the group comprising a front windshield, side window, rear windshield, headlight cover or taillight cover.

Claim 8. The method of claim 1 wherein said hard coat layer protects said polycarbonate plastic layer from physical and chemical damage.

Claim 9. The method of claim 8 wherein said hard coat layer is made of an acrylic based material.

Claim 10. The method of claim 1 wherein said hard coat layer is partially cured.

Claim 11. The method of claim 1 wherein said hard coat layer is fully cured.

Claim 12. A finished part comprising:
a polycarbonate substrate layer formed in the shape of one selected from a group comprising a front windshield, side window, rear windshield, headlight cover or taillight cover; and
a hard coat layer adhered to one or more sides of said polycarbonate substrate layer, wherein said hard coat protects said polycarbonate substrate layer from physical and chemical damage.

Claim 13. The finished part of claim 12 wherein said hard coat layer is acrylic based.

Claim 14. The finished part of claim 12 wherein said polycarbonate substrate layer and said hard coat layer are transparent.

Claim 15. The finished part of claim 12 wherein said polycarbonate substrate layer is colored.

Claim 16. The finished part of claim 12 further comprises a second polycarbonate substrate layer adhered to said first polycarbonate substrate layer.

Claim 17. The finished part of claim 16 wherein said second polycarbonate substrate layer is colored and said first polycarbonate substrate layer and said hard coat layer are transparent.

Claim 18 The finished part of claim 16 further comprising a second hard coat layer adhered to said second polycarbonate substrate layer.

Claim 19. The finished part of claim 18 wherein said first hard coat layer and said second hard coat layer are acrylic based.

Claim 20. The finished part of claim 12 wherein said hard coat layer is applied to the surface of said polycarbonate substrate layer by a process selected from the group comprising spring, injection molding, compression molding and combinations thereof.

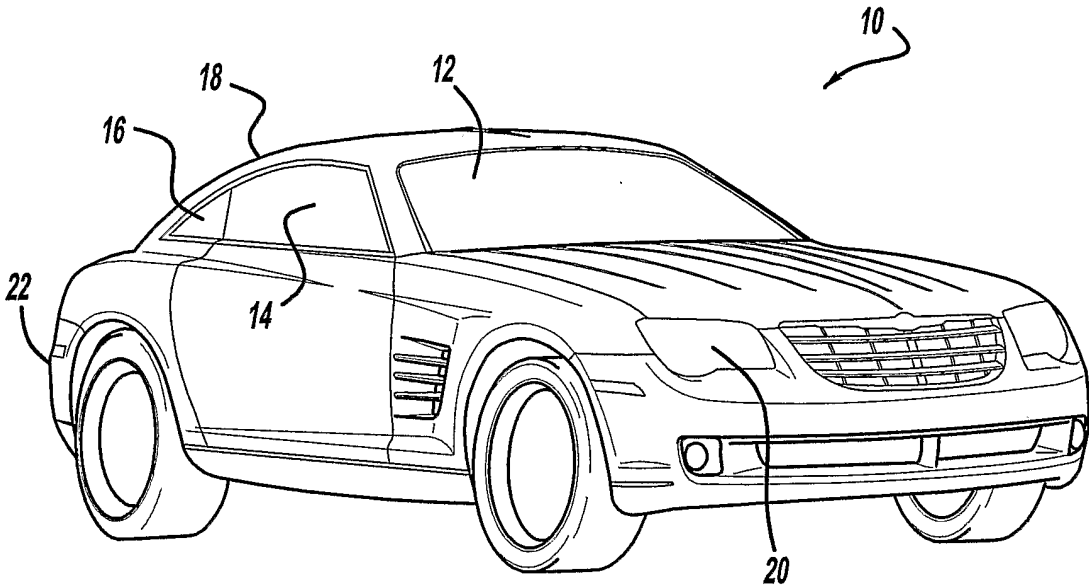


FIG - 1

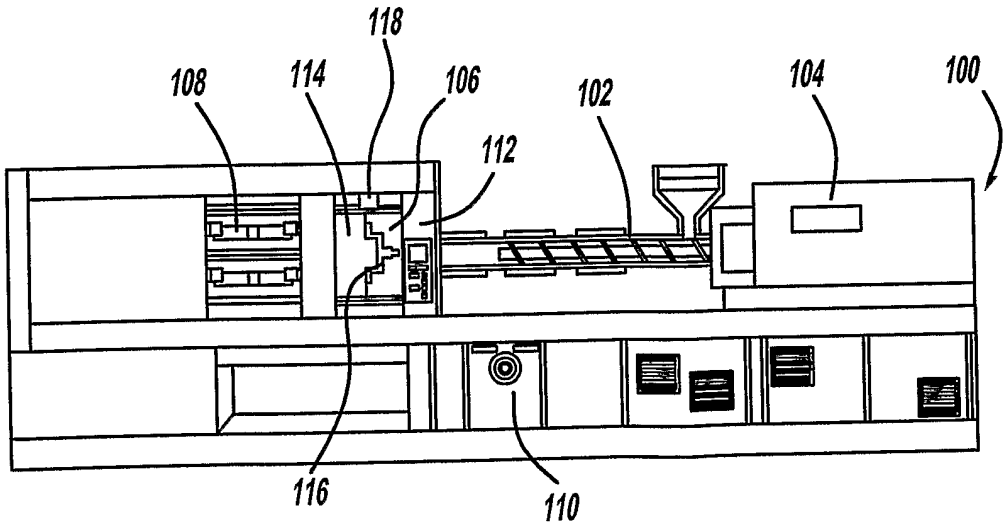


FIG - 2

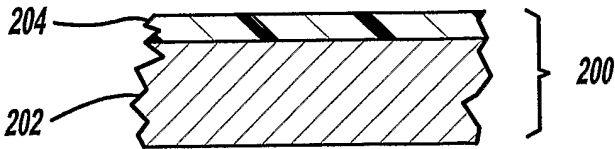


FIG - 3

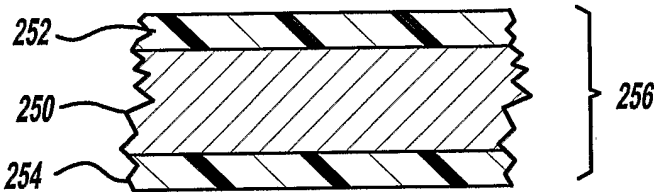


FIG - 3a

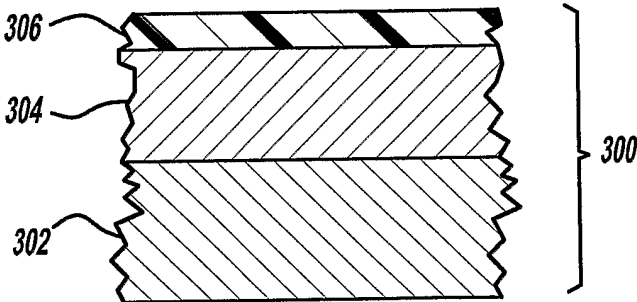


FIG - 4

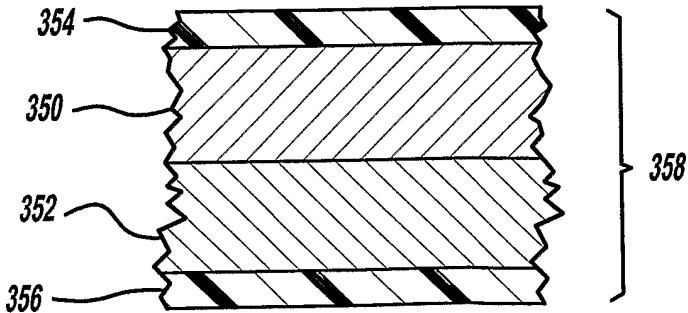


FIG - 4a

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2006/000012

A. CLASSIFICATION OF SUBJECT MATTER

IPC: **C08J 7/04** (2006.01) , **B32B 27/08** (2006.01) , **B29C 37/00** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: **C08J 7/04** (2006.01) , **B32B 27/08** (2006.01) , **B29C 37/00** (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)

Canadian Patent Database, Delphion, STN-CAPLUS, USPTO, Espacenet, ("polycarbonate", "hard", "coat", "windshield", "window")

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CA 2,396,436 (MITSUBISHI HEAVY IND) 03 February 2003 abstract, pages 3, 8	1-20
X	JP 2003 103691 (ASAHI GLASS) 09 April 2003 abstract	1-20
X	JP 2004 027108 (TEIJIN CHEM) 29 January 2004 abstract, see also JP 2004 027109, JP 2004 027110, JP 2004 027111	1-20
X	JP 2004 035609 (TEIJIN CHEM) 05 February 2004 abstract, see also JP 2004 035610, JP 2004 035611	1-20
X	JP 2004 167946 (IDEMITSU PETROCHEM) 17 June 2004 abstract	1-20
X	US 4,293,659 (FREEMAN CHEM.) 06 October 1981 abstract	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2006/000012

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
CA2396436	03-02-2003	BR0203611 A EP1281613 A2 JP3572300B2 US6756126 B2	20-05-2003 05-02-2003 29-09-2004 29-06-2004
JP2003103691	09-04-2003	none	
JP2004027108	29-01-2004	none	
JP2004035609	05-02-2004	none	
JP2004167946	17-06-2004	none	
US4293659	06-10-1981	CA1132288 A1 JP1035855B B US4366109 A	21-09-1982 27-07-1989 28-12-1982