(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 October 2016 (06.10.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/155579 A1

(51) International Patent Classification:
B29C 45/17 (2006.01)

(21) International Application Number:
PCT/CN2016/077414

(22) International Filing Date:
25 March 2016 (25.03.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
201510149167.9 31 March 2015 (31.03.2015) CN

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) Title: INJECTION MOLDED COMPONENT AND METHOD FOR FORMING THE SAME, ENCAPSULATION STRUCTURE AND VEHICLE WINDOW

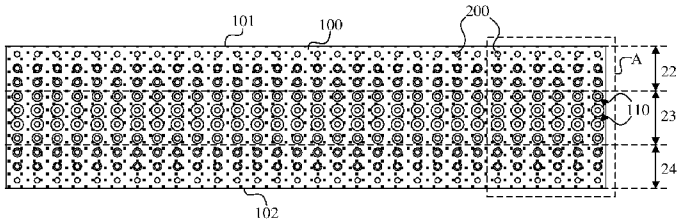


FIG. 3

(57) Abstract: An injection molded component and a method thereof, an encapsulation structure and a vehicle window are provided. The injection molded component(10) includes a body part(100) and a plurality of voids(110) distributed at least in a middle part(23) of the body part(100), wherein the plurality of voids(110) contain a plurality of buffer particles(200). The method includes: providing injection molding raw material; mixing a plurality of buffer particles in the injection molding raw material; melting the injection molding raw material to form injection molding material; injecting the injection molding material into a mold; cooling the injection molding material to form an injection molded component, during which a portion of the injection molding material is separated from the plurality of buffer particles to form a plurality of voids.

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INJECTION MOLDED COMPONENT AND METHOD FOR FORMING THE SAME, ENCAPSULATION STRUCTURE AND VEHICLE WINDOW

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to Chinese patent application No. 201510149167.9, filed on March 31, 2015, and entitled "INJECTION MOLDED COMPONENT AND METHOD FOR FORMING THE SAME, ENCAPSULATION STRUCTURE AND VEHICLE WINDOW", the entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure generally relates to vehicle technology, and more particularly, to an injection molded component, a method for forming the injection molded component, an encapsulation structure and a vehicle window.

BACKGROUND

[0003] Generally, for improving sealing performance of vehicle windows and the vehicle windows' better fitting in a car bodywork, encapsulation structures having sealing function are disposed between the vehicle windows and the car bodywork.

[0004] A conventional encapsulation structure is usually an injection molded component formed by an injection molding process. That is, injection molding raw material are melted and injected into a mold for molding and cooling, so as to form the injection molded component. However, when the injection molding raw material is cooled in the mold in a high temperature molten state, due to the different heat transmission speeds in the injection molding material, a part of the injection molding material at the surface is firstly cooled, hardened and then solidified, but a part of the injection molding material at the interior is cooled down more slowly. In the cooling process, the part of the injection molding material at the interior shrinks and generates a shrinkage force pulling the part of the injection molding material at the surface

inwards, which results in a deformation and a sinking of the surface of the injection molded component. Therefore, not only production yield and external appearance of the injection molded component may be affected, but also the encapsulation structure cannot be even mounted in the car bodywork, or assembly of the encapsulation structure and other structures is affected.

SUMMARY

[0005] Therefore, there is a need for an injection molded component, a method for forming the injection molded component, an encapsulation structure and a vehicle window to reduce a risk of deformation and sinking at a surface of the conventional injection molded component.

[0006] According to one aspect of the present disclosure, an injection molded component is provided. The injection molded component at least includes a body part, wherein the body part includes a first part, a second part opposite to the first part, and a middle part between the first part and the second part, and wherein the injection molded component further includes a plurality of voids distributed at least in the middle part, wherein the plurality of voids contain a plurality of buffer particles.

[0007] A basic idea lies in that a plurality of voids are distributed at least in the middle part of the injection molded component, and the plurality of voids contain a plurality of buffer particles. In the process for forming the injection molded component, the buffer particles are distributed at least in the middle part serving as fillers, which may reduce a risk of deformation and sinking at a surface of the injection molded component. Further, in the cooling and shrinking process of the injection molded component, the middle part of the injection molded component is cooled to shrink, and then is detached and separated from the buffer particles therein in the shrinking process to form the voids. The formation of the voids can reduce a pull force that the middle part of the injection molded component applies on the surfaces of the injection molded component in the shrinking process. Therefore, the voids may be used to reduce or neutralize the deformation and the sinking at surfaces

of the injection molded component, and thus improve the production yield of the injection molded component.

[0008] Furthermore, a thermal expansion coefficient of the buffer particles is smaller than that of the injection molded component. Thus, in the cooling process for forming the injection molded component, the buffer particles shrink for a small volume due to the small thermal expansion coefficient, while the injection molded component itself shrinks for a large volume due to the large thermal expansion coefficient, which makes for the injection molded component to detach and separate from the buffer particles, so as to form the voids.

[0009] According to one aspect of the present disclosure, a method for forming an injection molded component is provided. The method includes: providing injection molding raw material; mixing a plurality of buffer particles in the injection molding raw material; melting the injection molding raw material to form injection molding material; injecting the injection molding material containing the plurality of buffer particles into a mold; and cooling the injection molding material to form an injection molded component, during which a portion of the injection molding material which is not in contact with sidewalls of the mold is separated from the plurality of buffer particles to form a plurality of voids.

[0010] A basic idea lies in that a plurality of buffer particles are mixed in the injection molding raw material. Then, in the process for injecting the injection molding material to the mold and the process for cooling and shrinking, the portion of the injection molding material which is not in contact with the mold sidewall is detached and separated from the buffer particles to form the voids. The formation of the voids can reduce a pull force that the middle part applies on the surfaces of the injection molded component in the shrinking process. Therefore, the formation of the voids may reduce or neutralize the deformation and the sinking formed at the surfaces of the injection molded component, and thus improves the production yield of the injection molded component.

[0011] Furthermore, a thermal expansion coefficient of the buffer particles is smaller than that of the injection molding raw material. Thus, in the cooling process for forming the injection molded component, the buffer particles shrink for a small volume due to the small thermal expansion coefficient, while the injection molded component itself shrinks for a large volume due to the large thermal expansion coefficient, which makes for the injection molded component to detach and separate from the buffer particles to form the voids.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 schematically illustrates an injection molded component formed by a conventional method;

[0013] FIG. 2 schematically illustrates a diagram of melted injection molding material in a cavity of a mold in a method for forming an injection molded component according to an embodiment of the present disclosure;

[0014] FIG. 3 schematically illustrates a diagram of voids generated when the injection molding material is cooled in a method for forming an injection molded component according to an embodiment of the present disclosure;

[0015] FIG. 4 schematically illustrates an enlarged cross-sectional view of the block A shown in FIG. 3;

[0016] FIG. 5 schematically illustrates a diagram of the buffer particles 200 and the voids 110 in the body part 100 according to an embodiment of the present disclosure; and

[0017] FIG. 6 schematically illustrates a cross-section view along the section B shown in FIG. 5.

DETAILED DESCRIPTION

[0018] The conventional encapsulation structure is usually an injection molded component, and the injection molded component is cooled to be molded in an injection molding process. FIG. 1 is a diagram illustrating an injection molded

component in the conventional technology. Referring to FIG. 1, in a process for cooling the injection molded component 10, the injection molded component 10 may shrink to some extent because of thermal expansion effect. Specifically, because a heat transmission speed at the surface part of the injection molded component is high, the injection molded component 10 is quickly cooled down to be solidified; in contrast, the internal part of the injection molded component 10 (please referring to the portion in block 12 shown in FIG. 1) is cooled down more slowly because of a low heat transmission speed. In the cooling process, the internal part of the injection molded component 10 shrinks gradually, and generates a pull force (please referring to the two rows of arrows shown in FIG. 1) on the surface of the injection molded component 10, which may results in a deformation and a sinking of the surface of the injection molded component 10 to some extent. Therefore, not only production yield and external appearance of the injection molded component may be affected, but also the encapsulation structure cannot be mounted in the car bodywork, or assembly of the encapsulation structure and other structures is affected.

[0019] In order to clarify the objects, characteristics and advantages of the disclosure, the embodiments of the present disclosure will be described in detail in conjunction with the accompanying drawings.

[0020] A method for forming an injection molded component is provided in an embodiment of the present disclosure. Referring to FIG. 2 to FIG. 4, diagrams are shown for intermediate structure formed in different steps of the method according to an embodiment.

[0021] First, injection molding raw material is provided. In an embodiment, polyvinyl chloride may be provided as the injection molding raw material. However, the material of the injection molding raw material should not be limited herein. In other embodiments of the present disclosure, thermoplastic polyamide or polyurethane also may be provided as the injection molding raw material.

[0022] After that, a plurality of buffer particles 200 (not shown) are mixed in the

injection molding raw material. The plurality of buffer particles 200 mixed in the injection molding raw material will be injected into a melting furnace of the injection molding process together with the injection molding raw material. The injection molding raw material will be melted to form injection molding material. However, the plurality of buffer particles 200 will not be melted, but will be injected into the mold together with the melted injection molding material, so as to be cooled and to be molded.

[0023] The plurality of buffer particles 200 may serve as fillers in the process of being injected into the mold. Namely, as the plurality of buffer particles 200 are mixed in the injection molding raw material and occupy a certain volume, the usage of the injection molding raw material can be reduced. Therefore, the injection molding raw material can be saved in an actual production process.

[0024] In a subsequent injection process, the plurality of buffer particles 200 may supports the injection molding material in a cooling process of the injection molding material, and a plurality of voids may be formed between the plurality of buffer particles 200 and the injection molding material around them. The formation of the plurality of buffer particles 200 may reduce a risk of deformation and sinking at surfaces 101 and 102 of the injection molded component. The reason will be described in detail hereunder.

[0025] In an embodiment, a thermal expansion coefficient of the buffer particles 200 may be smaller than that of the injection molding raw material, which is beneficial to reducing the risk of deformation and sinking at the surfaces 101 and 102 of the injection molded component. Specifically, in a cooling and shrinking process of the injection molding material, the buffer particles 200 have a small volume change (shrinkage) due to a small thermal expansion coefficient, while the injection molded component itself has a large volume change (shrinkage) due to a large thermal expansion coefficient. Therefore, the injection molded component will be easily detached and separated from the low volume changed buffer particles 200, and to form the plurality of voids.

[0026] In an embodiment, the buffer particles 200 include a material having a low thermal expansion coefficient. The low thermal expansion coefficient buffer particles 200 has a small volume change in a cooling process, which is further beneficial to the separation between the buffer particles 200 and the injection molding material around the buffer particles, and to the formation of the plurality of voids.

[0027] Specifically, in an embodiment, a linear thermal expansion coefficient of the buffer particle ranges from 0 to $8 \times 10^{(-6)}K^{-1}$. In this range, the buffer particle 200 is a positive expansion material. That is, in the cooling process, a volume of the buffer particle 200 will tend to shrink but not expand. The expansion coefficient of the buffer particle 200 in this range is not too large, such that it is not difficult to separate the buffer particle 200 from the injection molding material, and it is thus not difficult to form the voids. Meanwhile, with the expansion coefficient of the buffer particle 200 in this range, the volume change of the buffer particle 200 is not too large, and the appearance of the injection molded component is not affected. In addition, the buffer particles 200 in this range will not greatly affect other control parameters in the injection molding process, and then will not increase the complexity of the process.

[0028] Specifically, in an embodiment, the buffer particles 200 mixed in the injection molding raw material may be made of glass material. The glass material has a small adhesion force with the injection molding raw material, such that the buffer particles may be easily separated from the injection molding material to form the voids. Moreover, as a melting temperature of the glass material is higher than that of the injection molding raw material, the injection molding material itself will not be affected. In addition, it is easy to obtain the glass material in the production process.

[0029] However, the material of the buffer particle 200 is not limited to glass in the present disclosure. In other embodiments of the present disclosure, other materials may be used, such as ceramic, silicon oxide, iron nickel alloy or aluminum oxide, which also have a small adhesion force with the injection molding material.

[0030] In an embodiment, the buffer particles 200 mixed in the injection molding raw material may have a spherical shape. Forces applied on the spherical buffer particles 200 are evenly distributed, such that the spherical buffer particles 200 are not easily broken in the subsequent process for injecting the spherical buffer particles 200 and the melted injection molding material into the mold. Moreover, the spherical buffer particles 200 can reduce an impact on mobility of the injection molding material when the injection molding material is injected into the mold.

[0031] However, the present disclosure is not limited thereto. In other embodiments of the present disclosure, the buffer particles 200 mixed in the injection molding raw material may have other shapes. For example, the buffer particles 200 may have a cubic shape, which does not affect the implementation of the present invention.

[0032] Furthermore, in an embodiment, the buffer particles 200 mixed in the injection molding raw material may be hollow, which can save material for making the buffer particles 200 and reducing the weight of the buffer particles, and then the buffer particles 200 can be fully mixed with the melted injection molding material.

[0033] Similarly, the above embodiment is only an example of the present disclosure. In other embodiments of the present disclosure, the buffer particles 200 may be solid, which do not affect the implementation of the present invention. The present disclosure is not limited thereto.

[0034] In an embodiment, an average diameter of the buffer particles mixed in the injection molding raw material ranges from 1 to 200 micrometers. The size of the buffer particles 200 in this range is not too small, such that nano-agglomeration is not generated among the buffer particles 200 and uniformity of the buffer particles distributed in the melted injection molding material is not impacted. Further, the size of the buffer particles 200 is not too large. If the buffer particles are too large, they are easily broken in the process for injecting the buffer particles 200 and the melted injection molding material into the mold, and the mobility of the melted

injection molding material may be impacted or there may be no buffer particles 200 in a thinner part of the injection molded component. Because the thinner part of the injection molded component corresponds to a narrow portion of the mold cavity, the buffer particles 200 are difficult to enter this portion if the buffer particles 200 are too large.

[0035] Specifically, an average diameter of the plurality of the buffer particles may range from 30 to 120 micrometers, which is beneficial to manufacture of the buffer particles 200.

[0036] In an embodiment, a mass percent of the plurality of buffer particles 200 in the injection molded component is less than or equal to 10%. In this mass percent, the amount of the buffer particles 200 is not too large, such that performance (such as elasticity, structural strength, etc.) of the injection molded component is not impacted, or the appearance of the injection molded component is not impacted. Further, in this range, the amount of the buffer particles 200 is not too small, such that the amount of the voids is enough and the effect for reducing the deformation and the sinking of surfaces 101 and 102 of the injection molded component can be ensured.

[0037] Specifically, a mass percent of the plurality of buffer particles 200 in the injection molded component may range from 0.5% to 5.0%, such that not only the deformation and the sinking at the surfaces 101 and 102 of the injection molded component are reduced or neutralize, but also the buffer particles 200 are saved.

[0038] After the process that the buffer particles 200 are mixed in the injection molding raw material, the injection molding raw material is melted to form injection molding material. The injection molding raw material is melted in this step to form the injection molding material, but the buffer particles 200 are not melted.

[0039] Then, the injection molding material mixed with the plurality of buffer particles 200 is injected into a mold, so as to be cooled and be molded in subsequent processes. Referring to FIG. 2, a diagram illustrating the injection molding material in the cavity of the mold is provided according to an embodiment.

[0040] It should be noted that, a surface 101 (or 102) of the injection molding material shown in FIG. 2 is in contact with a sidewall of the mold, another surface 102 (or 101) is in contact with a surface of a glass to be encapsulated. However, the mold and the glass around the injection molded component are not illustrated. The rectangular shape of the injection molded component in FIG. 2 is only an example. In actual applications, the cavity of the mold should be adjusted according to actual requirements, so as to adjust the shape of injection molded component. This is a commonly used technique for those skilled in the art, and the shape of the injection molded component should not limit the scope of the present disclosure.

[0041] The portion of the injection molded component wherein the plurality of voids are formed is the body part 100. The body part 100 includes a first part 22, a second part 24 opposite to the first part 22, and a middle part 23 between the first part 22 and the second part 24. In this embodiment, as the injection molding material injected into the mold has been mixed with buffer particles 200, all the first part 22, the middle part 23 and the second part 24 of the body part 100 have been mixed with the buffer particles 200.

[0042] However, whether the first part 22 and the second part 24 have been mixed with the buffer particle 200 is not limited in the present disclosure. As described above, the inward pull force, which results in a deformation and a sinking of the surfaces 101 and 102 of the injection molded component, is mainly generated from the middle part 23 which is cooled slowly. In other embodiments of the present disclosure, the buffer particles 200 are only formed in the middle part 23 of the body part 100.

[0043] After the injection molding material mixed with buffer particles 200 is injected into the mold and is molded, the melted injection molding material is cooled to be molded. Please referring FIG. 3 and FIG. 4, FIG. 3 is a diagram illustrating the voids generated when the injection molding material is cooled, and FIG. 4 is an enlarged cross-sectional view of the block A shown in FIG. 3. In the cooling and shrinking process of the injection molding material, a portion of injection molding

material, which is not in contact with the sidewall of the mold (namely, the sidewall of the cavity), is separated from the buffer particles 200 to form the voids 110, so as to form the injection molded component.

[0044] Specifically, the heat transmission speed is higher at a portion where the injection molding material is in contact with the mold or the glass, thus the injection molding material is cooled to be molded quickly. As the cooling time for the surface portion is short, a shrinkage and a deformation of the injection molding material at this portion is small. However, the farther the injection molding material is away from the mold sidewall or the glass surface, the lower the heat transmission speed is, and the longer the time for cooling and molding is. The injection molding material is shrinking in all the cooling process. However, as the buffer particles 200 are mixed in the injection molding material, in the cooling process, the interface defects between the injection molding material and the buffer particles 200 make the voids 110 (which is formed due to the mismatch of the thermal expansion coefficients between the injection molding material and the buffer particles) formed earliest at the interface between the injection molding material and the buffer particles 200, such that the buffer particles 200 are detached and separated from the injection molding material to generate the voids 110. The generation of the voids releases the stress generated in the shrinking process of the injection molding material at the voids 110, and reduces cohesion force of the injection molding material. Both the release of the stress and the reduction of the cohesion force reduce the pull force that the middle part 23 of the injection molding material applies on the surfaces of the injection molding material. Therefore, even though the injection molding material at the middle part 23 cools and shrinks continuously, only the formed voids 110 are enlarged, but the surfaces 101 and 102 of the formed injection molded component are impacted little. Therefore, the risk of deformation and sinking of the surfaces 101 and 102 of the injection molded component is reduced, and the yield of the injection molded component is improved.

[0045] Furthermore, the plurality of buffer particles 200 may serve as fillers in

some extent, so as to support the injection molding material mechanically. Therefore, the problem of the deformation and the sinking of the surfaces 101 and 102 of the injection molded component can be solved in some extent.

[0046] Furthermore, as described above, the farther the injection molding material is away from the mold sidewall, the lower the heat transmission speed is, the longer the time for molding is, and the more serious the shrinkage of the injection molding material is. That is, the closer the injection molding material is near the mold sidewall, the higher the cooling speed is, the higher the molding speed of injection molding speed is, and the smaller the shrinkage of the injection molding material is. Moreover, as the buffer particles 200 are also mixed in the first part 22 and the second part 24 of the body part 100, the voids 110 are also formed in the first part 22 and the second part 24, and the average diameter of the voids is reduced gradually in a direction from the middle part 23 of the body part 100 to the surface 101 or 102 of the body part 100 (please referring to the size distribution of the voids shown in FIG. 3 and FIG. 4). In an embodiment, in the injection process, the first part 22 is the portion near the mold, the second part 24 is the portion near the glass surface, and at least in a direction from the middle part 23 to the surface 101 of the body part 100, the average diameter of the voids is reduced gradually.

[0047] Furthermore, FIG. 3 and FIG. 4 only schematically illustrate the voids 100 including the buffer particles 200. It should be noted that, the voids 110 formed in actual applications are not necessarily spherical, and the sectional shapes of the voids 110 are not necessarily spherical either. The shape of the voids 110 is determined by a number of factors (including the mismatch between the thermal expansion coefficients of the buffer particle 200 and the injection molding material, and the interface defects between the buffer particles and the injection molding material).

[0048] It also should be noted that, in the enlarged cross-sectional diagram of FIG. 4, the position relationship of the buffer particles 200 and the injection molding material is only an ideal state, or a cross-sectional view in a certain direction. The voids 110 are evenly formed at the entire boundary of the buffer particles 200 (that is,

the buffer particles 200 are not in contact with the injection molding material). However, in the body part 100 formed in an actual application, because of a number of factors, such as the gravity of the buffer particle, uneven tension forces at different portion when the injection molding material and the buffer particles 200 are separated, etc, the buffer particles are not suspended in the voids to be not in contact with around injection molding material. Therefore, some voids 110 don't surround the entire boundary of the buffer particles 200 or are not evenly formed around the buffer particles 200. Please referring to FIG. 5, a diagram of the buffer particles 200 and the voids 110 formed in an actual application is illustrated. The buffer particles 200 and the cooled injection molding material may contact at a point or at a partial surface. In this situation, the cross-sectional view of FIG. 5 along a section A is similar to the diagrams shown in FIG. 3 and FIG. 4. The voids 110 are around the buffer particles 200. Please referring to FIG. 6, a cross-section view along a section B is illustrated, and the buffer particles 200 and the cooled injection molding material contact at a point or a partial surface.

[0049] Therefore, the term "the plurality of voids contain a plurality of buffer particles" used in the present disclosure, not only includes a situation that the buffer particles 200 is not in contact with the injection molding material, but also includes a situation that the buffer particles 200 and the cooled injection molding material contact at a point or a partial surface.

[0050] Furthermore, an injection molded component is provided in embodiments of the present disclosure. Referring to FIG. 3 and FIG. 4, FIG. 4 is an enlarged cross-sectional view of the block A shown in FIG. 3. The injection molded component at least includes a body part 100, where the body part 100 includes a first part 22, a second part 24 opposite to the first part 22, and a middle part 23 between the first part 22 and the second part 24, wherein the injection molded component further includes a plurality of voids 110 distributed at least in the middle part 23, wherein the plurality of voids 110 includes a plurality of buffer particles 200.

[0051] In the process for forming the injection molded component, the buffer

particles distributed at least in the middle part 23 may reduce a risk of deformation and sinking of surfaces 101 and 102 of the injection molded component. The reason is described as follows. The heat transmission speed is higher at a portion where the injection molding material is in contact with the mold or the glass, thus the injection molding material is cooled to be molded quickly. As the cooling time for the surface portion is short, a shrinkage and a deformation of the injection molding material at this portion is small. However, the farther the injection molding material is away from the mold sidewall or the glass surface, the lower the heat transmission speed is, and the longer the time for cooling and molding is. The injection molding material is shrinking in all the cooling process. As the buffer particles 200 are mixed in the injection molding material, in the cooling process, the interface defects between the injection molding material and the buffer particles 200 make the voids 110 (which is formed due to the mismatch between the thermal expansion coefficients of the injection molding material and the buffer particles) formed earliest at the interface between the injection molding material and the buffer particles 200, such that the buffer particles 200 are detached and separated from the injection molding material to generate the voids 110. The generation of the voids releases the stress generated in the shrinking process of the injection molding material at the voids 110, and reduces cohesion force of the injection molding material. Both the release of the stress and the reduction of the cohesion force reduce the pull force that the middle part 23 of the injection molding material applies on the surfaces of the injection molding material. Therefore, even though the injection molding material at the middle part 23 cools and shrinks continuously, only the formed voids 110 are enlarged, but the surfaces 101 and 102 of the formed injection molded component are impacted little. Therefore, the risk of deformation and sinking of the surfaces 101 and 102 of the injection molded component is reduced, and the yield of the injection molded component is improved.

[0052] Furthermore, the plurality of buffer particles 200 may serve as fillers in some extent, so as to support the injection molding material mechanically. Therefore, the problem of the deformation and the sinking of the surfaces 101 and 102 of the

injection molded component can be solved in some extent.

[0053] Furthermore, as described above, the farther the injection molding material is away from the mold sidewall, the lower the heat transmission speed is, the longer the time for molding is, and the more serious the shrinkage of the injection molding material is. That is, the closer the injection molding material is near the mold sidewall, the higher the cooling speed is, the higher the molding speed of injection molding speed is, and the smaller the shrinkage of the injection molding material is. Moreover, as the buffer particles 200 are also mixed in the first part 22 and the second part 24 of the body part 100, the voids 110 are also formed in the first part 22 and the second part 24, and the average diameter of the voids 110 is reduced gradually in a direction from the middle part 23 of the body part 100 to the surface 101 or 102 of the body part 100 (please referring to the size distribution of the voids shown in FIG. 3 and FIG. 4).

[0054] In an embodiment, the material of the injection molded component may be polyvinyl chloride. However, the material of the injection molded component should not be limited to the present disclosure. In other embodiments of the present disclosure, the material of the injection molded component may be thermoplastic polyamide or polyurethane.

[0055] In an embodiment, a thermal expansion coefficient of the buffer particles 200 may be smaller than that of the injection molded component. Thus, in the cooling process for forming the injection molded component, the buffer particles 200 have a small volume shrinkage due to a small thermal expansion coefficient, while the injection molded component itself has a large volume shrinkage due to a large thermal expansion coefficient. Therefore, the injection molded component will be easily detached and separated from the buffer particles 200, and to form the plurality of voids 110.

[0056] In an embodiment, the buffer particles 200 include a material having a low thermal expansion coefficient. The low thermal expansion coefficient buffer

particles 200 has a small volume change in a cooling process, which is further beneficial to the separation between the buffer particles 200 and the around injection molded component, and to the formation of the plurality of voids 110.

[0057] Specifically, in an embodiment, a linear thermal expansion coefficient of the buffer particle 200 ranges from 0 to $8 \times 10^{(-6)}K^{-1}$. In this range, the buffer particle 200 is a positive expansion material. That is, in the cooling process, a volume of the buffer particle 200 will tend to shrink but not expand. Meanwhile, the expansion coefficient of the buffer particle 200 in this range is not too large, such that it is not difficult to separate the buffer particle 200 from the injection molding material, and it is thus not difficult to form the voids. Meanwhile, with the expansion coefficient of the buffer particle 200 in this range, the volume change of the buffer particle 200 is not too large, and the appearance of the injection molded component is not affected. In addition, the buffer particles in this range will not greatly affect other control parameters in the injection molding process, and then will not increase the complexity of the process.

[0058] Specifically, in an embodiment, the material of the buffer particles 200 is glass. The glass material has a small adhesion force with the injection molded component, such that the buffer particles may be easily separated from the injection molded component to form the voids 110. Moreover, as a melting temperature of the glass material is higher than that of the injection molded component, the injection molded component itself will not be affected. In addition, it is easy to obtain the glass material in the production process.

[0059] However, the material of the buffer particle 200 is not limited to glass in the present disclosure. In other embodiments of the present disclosure, other materials may be used, such as ceramic, silicon oxide, iron nickel alloy or aluminum oxide, which also have a small adhesion force with the injection molded component.

[0060] In an embodiment, the buffer particles 200 may have a spherical shape. As forces applied on the spherical buffer particles 200 are evenly distributed, the

spherical buffer particles 200 are not easily broken in the process for injecting the spherical buffer particles 200 into the mold to form the injection molded component. Moreover, in the injection process for forming the injection molded component, the spherical buffer particles 200 has little impact on mobility of the melted injection molding material for forming the injection molded component.

[0061] The spherical buffer particles 200 may reduce an impact on mobility of the injection molding material when the melted injection molding material is injected into the mold.

[0062] However, the present disclosure is not limited thereto. In other embodiments of the present disclosure, the buffer particles 200 may have other shapes. For example, the buffer particles 200 may have a cubic shape, which does not affect the implementation of the present invention.

[0063] In an embodiment, the buffer particles 200 may be hollow particles, which can save material for making the buffer particles 200, and reducing the weight of the buffer particles 200, and then the buffer particles 200 can be fully mixed with the melted injection molding material.

[0064] However, the above embodiment is only an example of the present disclosure. In other embodiments of the present disclosure, the buffer particles 200 may be solid particles, which do not affect the implementation of the present invention. The present disclosure is not limited thereto.

[0065] In an embodiment, an average diameter of the buffer particles 200 ranges from 1 to 200 micrometers. The size of the buffer particles 200 in this range is not too small, such that nano-agglomeration is not generated among the buffer particles 200 and uniformity of the buffer particles distributed in the melted injection molding material is not impacted. Further, the size of the buffer particles 200 is not too large. If the buffer particles are too large, they are easily broken in the process for injecting the buffer particles 200 and the melted injection molding material into the mold, and the mobility of the melted injection molding material may be impacted or there may

be no buffer particles 200 in a thinner part of the injection molded component. Because the thinner part of the injection molded component corresponds to a narrow portion of the mold cavity, the buffer particles 200 are difficult to enter this portion if the buffer particles 200 are too large.

[0066] Specifically, an average diameter of the plurality of the buffer particles may range from 30 to 120 micrometers, which is beneficial to manufacture of the buffer particles.

[0067] In an embodiment, a mass percent of the plurality of buffer particles 200 in the injection molded component is less than or equal to 10%. In this mass percent, the amount of the buffer particles 200 is not too large, such that performance (such as elasticity, structural strength, etc.) of the injection molded component is not impacted, or the appearance of the injection molded component is not impacted. Further, in this range, the amount of the buffer particles 200 is not too small, such that the amount of the voids is enough and the effect for reducing the deformation and the sinking of surfaces 101 and 102 of the injection molded component can be ensured.

[0068] Specifically, a mass percent of the plurality of buffer particles 200 in the injection molded component may range from 0.5% to 5.0%, such that not only the deformation and the sinking at the surfaces 101 and 102 of the injection molded component are reduced or neutralize, but also the buffer particles 200 are saved.

[0069] Furthermore, FIG. 3 and FIG. 4 only schematically illustrate the voids 100 including the buffer particles 200. It should be noted that, the voids 110 formed in actual applications are not necessarily spherical, and the sectional shapes of the voids 110 are not necessarily spherical either. The shape of the voids 110 is determined by a number of factors (including the mismatch between the thermal expansion coefficients of the buffer particle 200 and the injection molding material, and the interface defects between the buffer particles and the injection molding material).

[0070] It also should be noted that, in the enlarged cross-sectional diagram of FIG. 4, the position relationship of the buffer particles 200 and the injection molding

material is only an ideal state, or a cross-sectional view in a certain direction. The voids 110 are evenly formed at the entire boundary of the buffer particles 200 (that is, the buffer particles 200 are not in contact with the injection molding material). However, in the body part 100 formed in an actual application, because of a number of factors, such as the gravity of the buffer particle, uneven tension forces at different portion when the injection molding material and the buffer particles 200 are separated, etc, the buffer particles 200 are not suspended in the voids to be not in contact with around injection molding material. Therefore, some voids 110 don't surround the entire boundary of the buffer particles 200 or are not evenly formed around the buffer particles 200. Please referring to FIG. 5, a diagram of the buffer particles 200 and the voids 110 formed in an actual application is illustrated. The buffer particles 200 and the cooled injection molding material may contact at a point or at a partial surface. In this situation, the cross-sectional view of FIG. 5 along a section A is similar to the diagrams shown in FIG. 3 and FIG. 4. The voids 110 are around the buffer particles 200. Please referring to FIG. 6, a cross-section view along a section B is illustrated, and the buffer particles 200 and the cooled injection molding material contact at a point or a partial surface.

[0071] Therefore, the term "the plurality of voids contain a plurality of buffer particles" used in the present disclosure, not only includes a situation that the buffer particles 200 is not in contact with the injection molding material, but also includes a situation that the buffer particles 200 and the cooled injection molding material contact at a point or a partial surface.

[0072] Further, the injection molded component of the present disclosure can be formed by the method described above, but is not limited to the method described above.

[0073] Furthermore, an encapsulation structure is provided in embodiments of the present disclosure. The encapsulation structure may include the injection molded component described above. Moreover, in an embodiment, the encapsulation structure further includes a slot, wherein the slot is adapted for accommodating a glass.

However, the above embodiment is only an example, and the present disclosure is not limited thereto.

[0074] Furthermore, a vehicle window is provided in embodiments of the present disclosure, the vehicle window includes a glass, and the encapsulation structure described above, wherein the encapsulation structure is disposed at edges of the glass. However, the above embodiment is only an example, and the present disclosure is not limited thereto.

[0075] Although the present disclosure has been disclosed above with reference to preferred embodiments thereof, it should be understood by those skilled in the art that various changes may be made without departing from the spirit or scope of the disclosure. Accordingly, the present disclosure is not limited to the embodiments disclosed.

What is claimed is:

1. An injection molded component, at least comprising:

a body part, wherein the body part comprises a first part, a second part opposite to the first part, and a middle part between the first part and the second part, wherein the injection molded component further comprises:

a plurality of voids distributed at least in the middle part, wherein the plurality of voids contain a plurality of buffer particles.

2. The injection molded component according to claim 1, wherein a thermal expansion coefficient of the plurality of buffer particles is smaller than that of the injection molded component.

3. The injection molded component according to claim 1, wherein the plurality of buffer particles comprise a material having a low thermal expansion coefficient.

4. The injection molded component according to claim 3, wherein a linear thermal expansion coefficient of the plurality of buffer particles ranges from 0 to $8\times10^{(-6)}K^{-1}$.

5. The injection molded component according to claim 1, wherein the plurality of voids containing the plurality of buffer particles are also distributed in the first part and the second part of the injection molded component; and

wherein an average diameter of the plurality of voids is gradually reduced in a direction from the middle part to at least a surface of the body part.

6. The injection molded component according to claim 1, wherein the plurality of the buffer particles have a spherical shape or a cubic shape.

7. The injection molded component according to claim 1, wherein an average diameter of the plurality of the buffer particles ranges from 1 to 200 micrometers.

8. The injection molded component according to claim 1, wherein an average diameter of the plurality of the buffer particles ranges from 30 to 120 micrometers.

9. The injection molded component according to claim 1, wherein the plurality of the buffer particles comprise a material selected from a group consisting of glass, ceramic, silicon oxide, iron nickel alloy and aluminum oxide.

10. The injection molded component according to claim 1, wherein the plurality of the buffer particles are hollow particles or solid particles.

11. The injection molded component according to claim 1, wherein a mass percent of the plurality of buffer particles in the injection molded component is less than or equal to 10%.

12. The injection molded component according to claim 1, wherein a mass percent of the plurality of buffer particles in the injection molded component ranges from 0.5% to 5.0%.

13. The injection molded component according to claim 1, wherein the injection molded component comprises a material selected from a group consisting of polyvinyl chloride, thermoplastic polyamide, and polyurethane.

14. A method for forming an injection molded component, comprising:

providing injection molding raw material;

mixing a plurality of buffer particles in the injection molding raw material;

melting the injection molding raw material to form injection molding material;

injecting the injection molding material containing the plurality of buffer particles into a mold; and

cooling the injection molding material to form an injection molded component,

during which a portion of the injection molding material which is not in contact with sidewalls of the mold is separated from the plurality of buffer particles to form a plurality of voids.

15. The method according to claim 14, wherein a thermal expansion coefficient of the plurality of buffer particles is smaller than that of the injection molding raw material.

16. The method according to claim 14, wherein the plurality of buffer particles comprise a material having a low thermal expansion coefficient.

17. The method according to claim 16, wherein a linear thermal expansion coefficient of the plurality of buffer particles ranges from 0 to $8\times10^{(-6)}K^{-1}$.

18. The method according to claim 14, wherein the portion of the injection molded component wherein the plurality of voids are formed is a body part, and the body part comprises a first part, a second part opposite to the first part, and a middle part between the first part and the second part; and

the step of forming an injection molded component comprises forming the plurality of voids in the middle part, the first part and the second part, and an average diameter of the plurality of voids is gradually reduced in a direction from the middle part to at least a surface of the body part.

19. The method according to claim 14, wherein the plurality of buffer particles mixed in the injection molding raw material have a spherical shape or a cubic shape.

20. The method according to claim 14, wherein the plurality of buffer particles mixed in the injection molding raw material are hollow particles or solid particles.

21. The method according to claim 14, wherein an average diameter of the plurality of buffer particles ranges from 1 to 200 micrometers.

22. The method according to claim 14, wherein a mass percent of the plurality of buffer particles in the injection molded component is less than or equal to 10%.

23. The method according to claim 14, wherein the injection molding raw material comprises a material selected from a group consisting of polyvinyl chloride, polyurethane, and thermoplastic polyamide.

24. An encapsulation structure, comprising:

the injection molded component according to any one of claims 1-13.

25. The encapsulation structure according to claim 24, further comprising: a slot for accommodating a glass.

26. A vehicle window, comprising:

a glass; and

the encapsulation structure according to claim 24, wherein the encapsulation structure is disposed at edges of the glass.

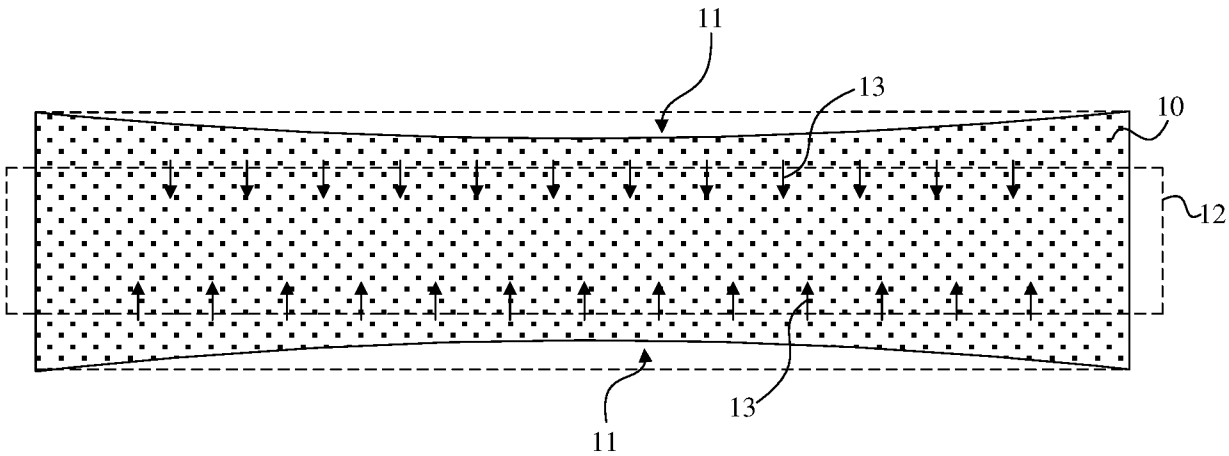


FIG. 1

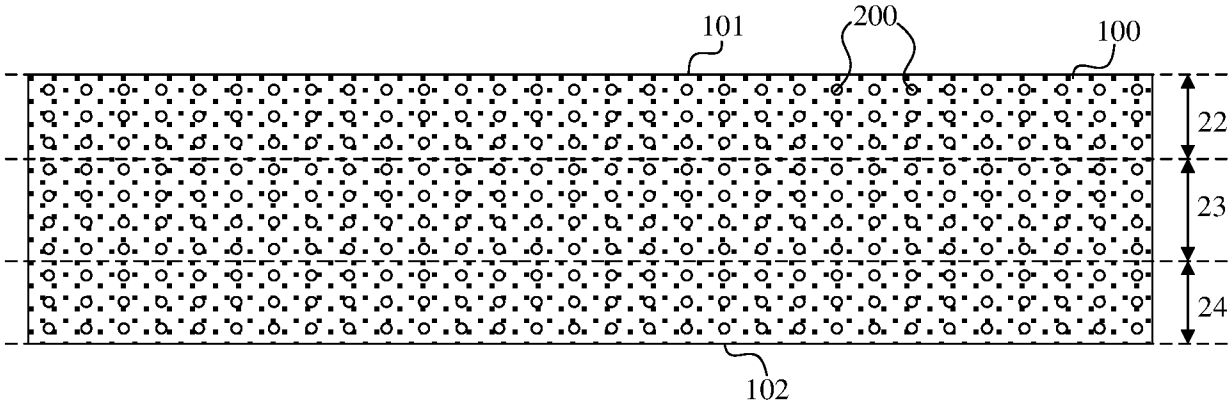


FIG. 2

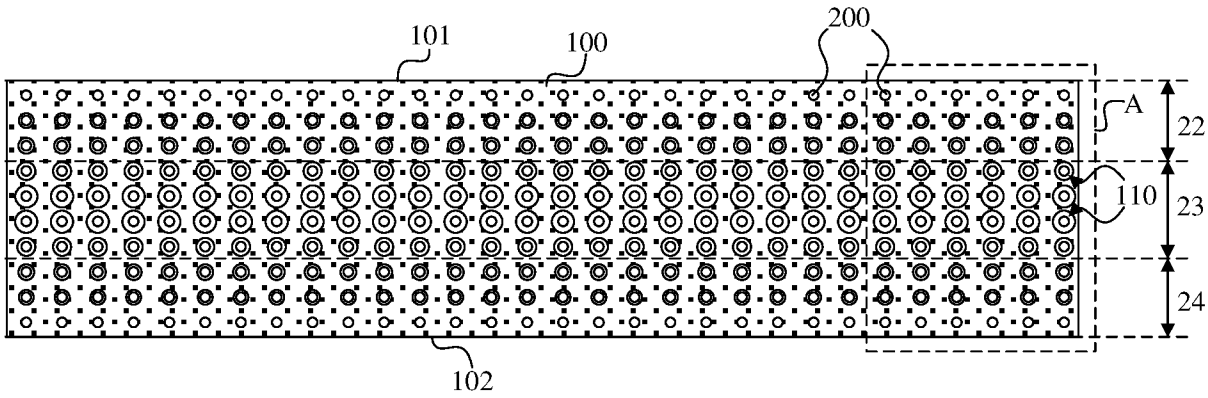


FIG. 3

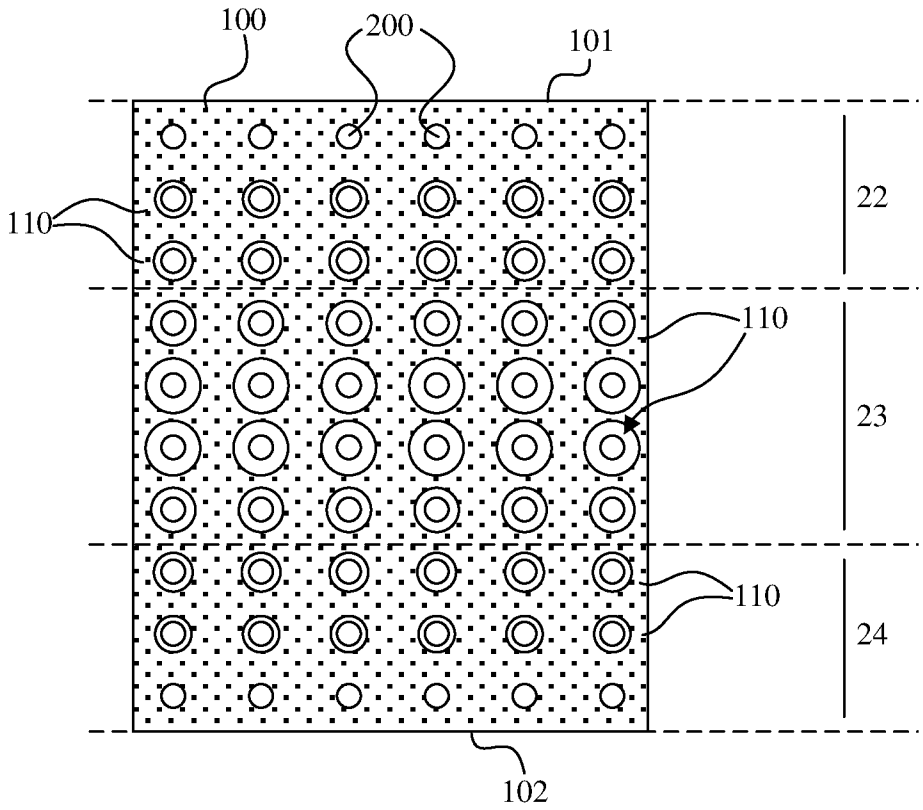


FIG. 4

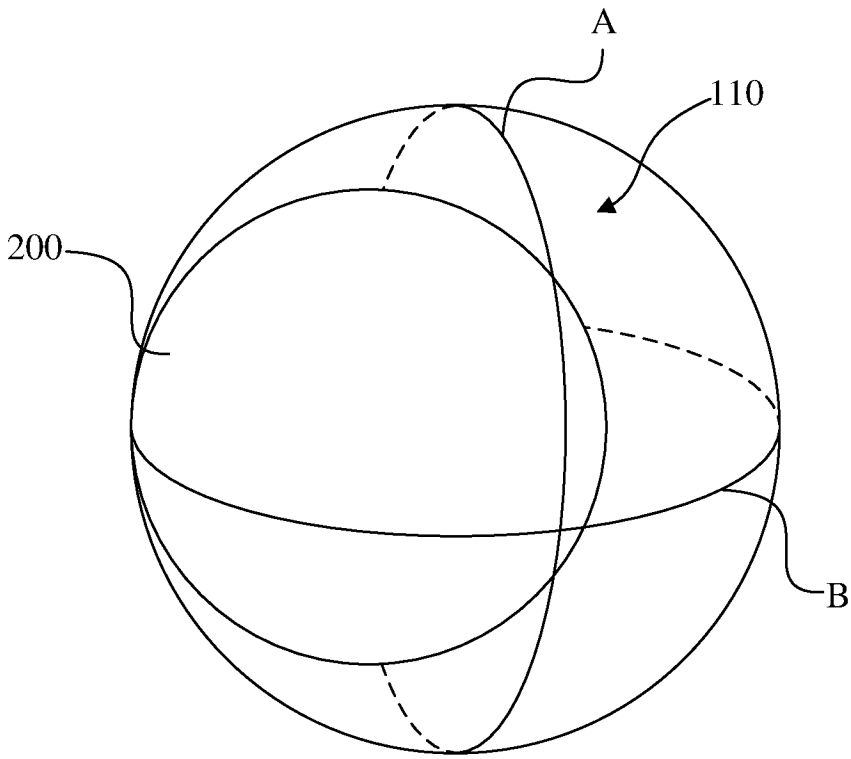


FIG. 5

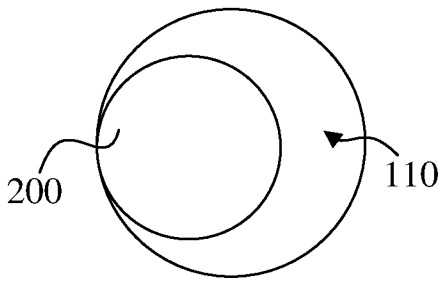


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/077414

A. CLASSIFICATION OF SUBJECT MATTER

B29C 45/17(2006.01)i

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)

B29C

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

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

VEN,CNKI,CNABS:particle, grain?, filling, void?, distortion, expansion coefficient, shrink, cushion

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 102213779 A (CANON KK) 12 October 2011 (2011-10-12) claims 1 and 6, description, paragraphs [0037]- [0045], and figure 1	1-26
A	JP 2000239770 A (WALL COLMONOY CORP) 05 September 2000 (2000-09-05) the whole document	1-26
A	US 2014054038 A1 (SCHLUMBERGER TECHNOLOGY CORP) 27 February 2014 (2014-02-27) the whole document	1-26

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"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)

"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

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 May 2016	**15 June 2016**
Name and mailing address of the ISA/CN **STATE INTELLECTUAL PROPERTY OFFICE OF THE P.R.CHINA** **6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088, China** Facsimile No. **(86-10)62019451**	Authorized officer **JIN,Yanying** Telephone No. **(86-10)62084975**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2016/077414

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
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				US	2011242672	A1	06 October 2011
				CN	102213779	B	26 March 2014
				EP	2372405	A1	05 October 2011
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				EP	1036611	A2	20 September 2000
				EP	1036611	A3	20 December 2000
US	2014054038	A1	27 February 2014	WO	2014035776	A1	06 March 2014
				US	9096467	B2	04 August 2015