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Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

(54) Title: CYCLOOLEFIN COPOLYMER BOTTLE WITH A SCRATCH-RESISTANT COATING

(54) Bezeichnung: CYCLOOLEFIN-COPOLYMER-FLASCHE MIT EINEM KRATZFESTEN ÜBERZUG

(57) Abstract: The invention relates to a bottle made from plastic, including or made from cycloolefin copolymer, with a coating of an inorganic/organic hybrid polymer (ORMOCER coating) .

(57) Zusammenfassung: Die Erfindung betrifft eine Flasche aus Kunststoff, umfassend oder bestehend aus Cycloolefin-Copolymer, mit einer Beschichtung aus einem anorganisch-organischen Hybrid- Polymer (ORMOCER-Beschichtung) .

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Cycloolefin copolymer bottle having a scratch-resistant covering

The invention relates to cycloolefin copolymer bottles having a scratch-resistant covering.

Containers made of plastics have the advantage over glass containers of being low in weight and having a high degree of break resistance. A disadvantage of plastics containers is, however, their high susceptibility to scratching.

Plastics bottles are frequently used for pharmaceutical preparations. For the production of the preparations, the plastics bottles are often sterilised together with the pharmaceutical preparation. Commercially available plastics bottles contain polyethylene propylene (PEP) or polypropylene (PP) and are not autoclavable but have to be radiation-sterilised or sterilised with ethylene oxide. Those plastics bottles have the additional disadvantage that they are milky and for that reason visual inspection of the contents of the bottle is not possible. A bottle made of cycloolefin copolymer (COC) is clear, but is highly susceptible to scratching.

The problem of the invention is to provide a clear, coated plastics bottle the outer surface of which is unsusceptible to scratching. The plastics bottles should be suitable for use on the customary filling apparatus for liquid pharmaceutical preparations or pharmaceutical powders. In addition, the plastics bottle should be autoclavable.

The problem underlying the invention is now solved by a bottle made of plastics, comprising or consisting of cycloolefin copolymer, having a coating of an inorganic-organic hybrid polymer (ORMOCER coating).

Surprisingly, it has been found that plastics bottles made of cycloolefin copolymer having an ORMOCER coating are autoclavable and are not susceptible to scratching. In addition, the ORMOCER covering adheres well to the COC surface.

For the bottles according to the invention, the cycloolefin copolymer can be a copolymer of ethylene and cycloolefin.

For the bottles according to the invention, the ethylene can be unsubstituted or substituted.

Furthermore, for the bottle according to the invention, the cycloolefin can be dicyclopentadiene or a dicyclopentadiene derivative.

For the bottle according to the invention, the dicyclopentadiene or dicyclopentadiene derivative can be unsubstituted or substituted.

Furthermore, for the bottle according to the invention, the plastics can comprise or consist of a mixture of the cycloolefin polymer and a polymer from the group formed by polypropylene, polyvinyl chloride and polyvinylidene chloride.

Furthermore, the bottle according to the invention can be provided with a hybrid polymer coating comprising or consisting of

(i) a hydrolytic condensate, preparable from a silane of the formula R_mSiX_{4-m} having the following meanings:
R = crosslinkable organic radical
X = hydrolysable and condensable group
m = 1 or 2 or 3 (with 1 being preferred)
with a metal compound,

(ii) a prepolymer that is crosslinkable with the radicals R of the silane,

(iii) one or more (especially one or two) optional non-crosslinkable organofunctional silane(s) and

(iv) an optional low-volatility oxide.

For the bottle according to the invention, R in the silane formula can be a radical from the group formed by alkyl, alkenyl, alkynyl, aryl, arylalkyl, alkylaryl, arylalkenyl, alkenylaryl, arylalkynyl and alkynylaryl, it being possible for those radicals to be interrupted one or more times by an O atom and/or an S atom and/or an N atom and/or by an NH group, or to have a terminal OH, SH or NH_2 group.

For the bottle according to the invention, the radicals R in the silane formula can be, independently of one another, an unsubstituted radical or a radical substituted by one or more substituents from the group formed by halogen atoms, unsubstituted amino, amide, aldehyde, keto, alkylcarbonyl, carboxy, mercapto, cyano, isocyano, cyanato, isocyanato, hydroxy, alkoxy, alkoxycarbonyl, sulfonic acid, phosphoric acid, acrylic,

acryloxy, methacrylic, methacryloxy, glycidyl, glycidyloxy, epoxy and vinyl groups and such groups in substituted form.

For the bottle according to the invention, the radicals X in the silane formula can be, independently of one another, alkoxy groups, aryloxy groups, acyloxy groups, alkylcarbonyl groups, alkoxycarbonyl groups, hydroxy groups, halogen, hydrogen or substituted or unsubstituted amino groups.

For the bottle according to the invention, a prepolymer can be provided which carries a group R as reactive group, R having a meaning as detailed above.

Thus, for the bottle according to the invention a prepolymer can be provided which carries a group R as reactive group, R in the prepolymer and in the silane having the same meaning.

Furthermore, for the bottle according to the invention the silane and the prepolymer can be a combination as follows:

(i) silane having epoxy groups with epoxy resin as prepolymer and/or
(ii) silane having vinyl radicals with prepolymer having crosslinkable double bonds and/or
(iii) silane having polymerisable double bonds with prepolymer having crosslinkable double bonds and/or
(iv) mercapto-group-containing silane with prepolymer having crosslinkable double bonds and/or
(v) isocyanate-group-containing silane with polyol as prepolymer and/or
(vi) hydroxyl-group-containing silane with isocyanate as prepolymer and/or
(vii) amino-group-containing silane with epoxy resin as prepolymer.

Thus, the bottle according to the invention can be provided with a hydrolytic condensate of an acrylic-group-containing silane and with a prepolymer acrylate.

Furthermore, for the bottle according to the invention an optional non-crosslinkable organofunctional silane of the formula R'_mSiX_{4-m} having the following meanings can be provided:

R' = non-crosslinkable organic radical
X = hydrolysable and condensable group

m = 1 or 2 or 3.

For the bottle according to the invention, R' in the silane formula can be a radical from the group formed by alkyl, cycloalkyl, aryl, arylalkyl and alkylaryl, it being possible for those radicals to be interrupted one or more times by an O atom and/or an S atom and/or an N atom and/or by an NH group or to have a terminal OH, SH or NH_2 group.

Furthermore, for the bottle according to the invention, the radicals R' in the silane formula can be, independently of one another, an unsubstituted radical or a radical substituted by one or more substituents from the group formed by halogen atoms, unsubstituted amide, aldehyde, keto, alkylcarbonyl, carboxy, cyano, alkoxy and alkoxycarbonyl groups and such groups in substituted form.

Furthermore, for the bottle according to the invention the radicals X in the silane formula R'_mSiX_{4-m} can be, independently of one another, alkoxy groups, aryloxy groups, alkylcarbonyl groups, alkoxycarbonyl groups, hydroxy groups, halogen, hydrogen or substituted or unsubstituted amino groups.

Furthermore, for the bottle according to the invention a low-volatility oxide of compounds of elements of main group Ia, IIa, IIIa, IVa and/or Va or of sub-group IIb, IIIb, Vb, VIb, VIIb and/or VIIIb, with the exception of aluminium, can be provided.

Thus, for the bottle according to the invention B_2O_3, P_2O_5 and/or SnO_2 can be provided.

Furthermore, the bottle according to the invention can be provided with ABRASIL GA2-30, ABRASIL GA2-35 or ABRASIL VM-26-IPA2 as coating material.

Furthermore, the bottle according to the invention can have a cylindrical or prismatic or square shape.

Furthermore, the bottle according to the invention can be an injection bottle, a screw-closure bottle or an ampoule.

Furthermore, the bottle according to the invention can be an injection bottle or screw-closure bottle having a volume of from 1 to 1000 ml.

Furthermore, the bottle according to the invention can be an injection bottle having a volume of from 2 to 100 ml.

Furthermore, the bottle according to the invention can be an ampoule having a volume of from 1 to 20 ml.

Furthermore, the bottle according to the invention can be provided with a coating having a thickness of from 1 to 100 µm, especially from 2 to 30 µm and preferably from 8 to 20 µm.

Finally, the bottle according to the invention can be provided filled with a pharmaceutical preparation and closed with a closure.

The invention is described in greater detail below.

The term alkyl refers to a saturated, straight-chain or branched hydrocarbon group having especially from 1 to 20 carbon atoms, preferably from 1 to 12 carbon atoms, more especially from 1 to 6 carbon atoms, for example the methyl, ethyl, propyl, isopropyl, n-butyl, isobutyl, tert-butyl, n-hexyl, 2,2-dimethylbutyl or n-octyl group.

The terms alkenyl and alkynyl refer to at least partially unsaturated, straight-chain or branched hydrocarbon groups having especially from 2 to 20 carbon atoms, preferably from 2 to 12 carbon atoms, more especially from 2 to 6 carbon atoms, for example the ethenyl, allyl, acetylenyl, propargyl, isoprenyl or hex-2-enyl group. Preferably, alkenyl groups have one or two (preferably one) double bond(s) and alkynyl groups have one or two (preferably one) triple bond(s).

The term cycloalkyl refers to a cyclic group that has one or more rings (preferably 1 or 2) and contains especially from 3 to 14 ring carbon atoms, preferably from 3 to 10 ring carbon atoms. Examples are the cyclopropyl, cyclobutyl, cyclopentyl and cyclohexyl group.

The term aryl or Ar refers to an aromatic group that has one or more rings having especially from 6 to 14 ring carbon atoms, preferably from 6 to 10 (especially 6) ring carbon atoms. Examples are the phenyl, naphthyl or biphenyl group.

The terms arylalkyl, alkylaryl, arylalkenyl, alkenylaryl, arylalkynyl and alkynylaryl refer to groups which, in accordance with the above definitions, contain both aryl and alkyl, alkenyl or alkynyl groups. Specific examples are toluene, xylene, mesitylene, styrene, benzyl and cumene. Such a group preferably contains one or two aromatic rings having from 6 to 10 ring carbon atoms and one or two alkyl, alkenyl and/or alkynyl groups having from 1 or 2 to 6 carbon atoms.

Examples of non-crosslinkable organofunctional silanes are: bis-(dimethylamino)-methylphenylsilanes, bis-(mono-n-butylamino)dimethylsilanes, 2-chloroethyltrichlorosilanes, 2-chloroethylmethyldichlorosilanes, di-n-butyldichlorosilanes, diethyldiethoxysilanes, ethyltrimethoxysilanes, 8-bromooctyltrichlorosilanes, 3-bromopropyltrichlorosilanes, tert-butyltrichlorosilanes, 1-chloroethyltrichlorosilanes, chloromethyltrichlorosilanes, chlorophenyltrichlorosilanes, cyclohexyltrichlorosilanes, dimethyldichlorosilanes, diphenyldichlorosilanes, ethyldichlorosilanes. Special preference is given to phenyltrimethoxysilane, aminopropyltriethoxysilane and propyltrimethoxysilane.

Examples of crosslinkable organofunctional silanes are vinyltrimethoxysilane, aminopropyltriethoxysilane, isocyanatopropyltriethoxysilane, mercaptopropyltrimethoxysilane, vinyltriethoxysilanes, vinylethyldichlorosilanes, vinylmethyldiacetoxysilanes, vinylmethyldichlorosilanes, vinylmethyldiethoxysilanes, vinyltriacetoxysilanes, vinyltrichlorosilanes, phenylvinyldiethoxysilanes, phenylallyldichlorosilanes, 3-isocyanatoporyltriethoxysilanes, 3-isocyanatopropyltriethoxysilanes, methacryloxypropenyltrimethoxylsilanes, 3-methacryloxypropyltrimethoxysilanes. Special preference is given to methacryloxypropyltrimethoxysilane and 3-glycidyloxypropyltrimethoxysilane.

Examples of metal compounds are: $TiCl_4$, $ZrCl_4$, $Ti(OC_2H_5)_4$, $Ti(OC_3H_7)_4$, $Ti(O\text{-}iso\text{-}C_3H_7)_4$, $Ti(OC_4H_9)_4$, $Zr(O\text{-}iso\text{-}C_3H_7)$, $Zr(OC_4H_9)_4$, $Ti(acetylacetonato)_2(O\text{-}iso\text{-}C_3H_7)_2$, $Zr(acetylacetonato)_4$, $Ti(2\text{-}ethylhexyloxy)_4$ and other titanium or zirconium complexes with chelate ligands which are preferably coordinated by way of oxygen and/or nitrogen; $Al(OCH_3)_3$, $Al(OC_2H_5)_3$, $Al(O\text{-}n\text{-}C_3H_7)_3$, $Al(O\text{-}iso\text{-}C_3H_7)_3$, $Al(OC_4H_9)_3$, $Al(O\text{-}iso\text{-}C_4H_9)_3$, $Al(O\text{-}sec\text{-}C_4H_9)_3$, $AlCl_3$, $AlCl(OH)_2$, aluminium formate, aluminium acetate and aluminium oxalate as well as the corresponding (partially) chelated compounds, such as, for example, the acetylacetonates. Compounds that are liquid at room temperature, such as, for example, $Al(O\text{-}sec\text{-}C_4H_9)_3$ and $Al(O\text{-}iso\text{-}C_3H_7)_3$ are preferred.

Cycloolefin copolymer (COC) can be used as material for the plastics bottles. Cycloolefin copolymers are copolymers of ethylene and cyclic olefins. Suitable monomers are unsubstituted or substituted ethylenes. The cyclic olefin monomers are derived especially from dicyclopentadiene and can likewise be in unsubstituted or substituted form. The cycloolefin copolymers can be used in admixture with polypropylene, polyvinyl chloride or polyvinylidene chloride. It is preferable to use high-purity cycloolefin copolymers of substituted ethylene and substituted norbornene. They are available from Ticona under the trade name Topas®. They are distinguished by high break resistance, high transparency and high heat, radiation and chemical resistance. They are free of ions and heavy metals. They can be sterilised by means of autoclaving, ethylene oxide and gamma or electron radiation. In addition, they have pronounced barrier properties with respect to water vapour and oxygen. For example, Topas 8007, 6013 and 6015 exhibit lower permeability to water vapour and oxygen than polypropylene.

ORMOCERs (Organic Modified Ceramics) are understood as being inorganic-organic hydrid polymers. They are silicone polymers which are known as coating material for metals, glass, stone, etc. The preparation of the inorganic-organic hybrid polymers is described, for example, in DE 43 03 570 C.

For the synthesis of the hybrid polymers there are used functionalised silanes R_mSiX_{4-m}, wherein X is a hydrolysable and condensable group and R is a crosslinkable organic radical. The groups X can be, independently of one another, alkoxy groups, aryloxy groups, acyloxy groups, alkylcarbonyl groups, alkoxycarbonyl groups, halogen, hydrogen or substituted or unsubstituted amino groups. The crosslinkable radical R can be alkyl, alkenyl, alkynyl, aryl, arylalkyl, alkylaryl, arylalkenyl, alkenylaryl, arylalkynyl, alkynylaryl, it being possible for those radicals to be interrupted by O, S or N atoms or by NH groups, or to have terminal OH, SH or NH_2 groups, and to carry one or more substituents from the group of the halogens and substituted or unsubstituted amino, amide, aldehyde, keto, alkylcarbonyl, carboxy, mercapto, cyano, isocyano, cyanato, isocyanato, hydroxy, alkoxy, alkoxycarbonyl, sulfonic acid, phosphoric acid, acrylic, acryloxy, methacrylic, methacryloxy, epoxy, glycidyl, glycidyloxy or vinyl groups. The number m can have the value 1, 2 or 3. The compounds R_mSiX_{4-m} are combined with metal compounds such as halogen, alkyl, alkoxy, acyloxy or hydroxy compounds of aluminium, zirconium or titanium. The metal compounds can

be oligomeric in chelate compound form. It may also be a complexed or non-complexed aluminium salt with an organic or inorganic acid. In addition to comprising a hydrolytic condensate of R_mSiX_{4-m} with a metal compound, the coating material comprises a prepolymer. The prepolymers can react with the crosslinkable groups R and thus serve the crosslinking. Preferably, the prepolymers can have reacting groups that are identical to the radical R of the compound R_mSiX_{4-m}. For example, in the case of acrylic-group-containing silanes, acrylates are used as prepolymer. The coating material can, in addition, contain non-crosslinkable organofunctional silanes, for example having alkyl or aryl groups, and/or low-volatility oxides.

The preparation and use of the inorganic-organic hybrid polymers is effected by the hydrolysis of the starting compounds to form a colloidal solution which contains the split-off hydrolysis products, for example the alcohols, and which is termed a lacquer. If applicable, it is also possible to add lacquer solvents. Such a lacquer can be applied to the material to be coated. Once the Si-O-Si network has been formed, the cross-linking of the organic molecule groups takes place. That can be effected by polymerisation or polyaddition reactions.

As coating material there may be used ORMOCER lacquer ABRASIL GA2-30 or GA2-35 and Ormocer lacquer ABRASIL VM-26-IPA2. ORMOCER lacquer ABRASIL GA2-30 is a thermally hardening hybrid lacquer having a high degree of scratch resistance, high moisture and chemical resistance, a high-gloss surface and high thermal resistance. ABRASIL GA2-35, a variant of ABRASIL GA2-30, is likewise a thermally hardening hydrid lacquer. ABRASIL GA2-35 is a preparation having hydrolysed organically modified silicic acid esters, hydrolysed aluminium alkoxide and a complex-former. Also present are an epoxy resin and, as solvent, 2-butanol and methoxypropanol. ORMOCER lacquer ABRASIL VM-26-IPA2 is a UV-hardening hybrid lacquer having a high degree of scratch resistance. Preferably, ORMOCER lacquer ABRASIL GA2-30 and ABRASIL GA2-35 are used.

The plastics bottles according to the invention can be injection bottles (=vial), screw-closure bottles or ampoules.

The plastics bottles can have a cylindrical shape or have a rectangular base. Injection bottles or screw-closure bottles can contain a volume of from 1 to 1000 ml. The

volume of the injection bottles is preferably from 2 to 100 ml. Ampoules can contain a volume of from 1 to 20 ml.

The plastics injection bottles can be closed with rubber stoppers. Suitable materials for the rubber stoppers are chlorobutyl or bromobutyl rubber stoppers. The stopper can be provided with a crimped cap of a lightweight metal, for example of aluminium.

The screw-closure bottles can be closed with a screw closure made, for example, of aluminium.

The coated plastics bottles can be produced by the following process:

- coating of the COC bottles with an ORMOCER lacquer by means of vacuum vapour deposition, immersion, flood-coating, pouring, injection, spraying or brush application, preferably by spraying
- full hardening of the lacquer by UV or IR radiation or heat treatment at from 60 to 150°C, especially at 130°C

The layer thickness of the ORMOCER lacquer can be from 1 to 100 µm, especially from 2 to 30 µm. A layer thickness of from 8 to 20 µm is preferred.

The coated COC bottles can be filled with a pharmaceutical preparation.

The coated COC bottles can be autoclaved, radiation-sterilised or sterilised with ethylene oxide.

The sterilised COC bottles can be fed into the filling apparatus, the bottles being pressed tightly against one another by a holding ring to prevent them from falling over. The bottles are placed onto a conveyor belt with the aid of a turntable, the bottles still being held tightly pressed together by means of a holding ring. The action of the turntable and the holding ring causes the bottles to rub against one another, which in the case of uncoated plastics bottles would result in their outer surfaces becoming scratched. The bottles are transported by conveyor belt to the filling needles, where they are filled with the liquid in question. The bottles are then closed with a rubber stopper and crimped cap.

The filled plastics bottles according to the invention can be autoclaved. Autoclaving can be carried out at a temperature of at least 121°C, at a pressure of at least 2 bar for a period of at least 15 min. Alternatively, autoclaving at 110°C and a longer period in the autoclave is possible.

The invention is explained in greater detail by the following Example, but without the scope of the invention being limited thereby.

Example 1:

Substrate:	vials made of Topas
Lacquer:	Abrasil GA2-30
Pretreatment:	flame treatment on a mandrel
	before lacquering, wipe with acetone and blow off with compressed air
Application:	spraying
Full hardening:	130°C/1 hour

The COC bottles are pretreated by flame treatment before lacquering. The lacquer Abrasil GA2-30 is applied in a spraying process. The full hardening of the lacquer layer is effected in an oven at 130°C/1 hour. The film adheres well to the surface of the bottle. This is shown by a layer adhesion test by means of the cross-cut test (DIN ISO 2409).

The coated bottles are washed in a bottle-washing machine and dried in a sterilisation tunnel. The bottles are filled with an oxaliplatin solution in a filling/capping apparatus (for example VSR F01 from Bosch/Strunk) and then autoclaved at at least 121°C/2 bar/15 min. After passing through the filling apparatus, the bottles have no scratches.

Comprises/comprising and grammatical variations thereof when used in this specification are to be taken to specify the presence of stated features, integers, steps or components or groups thereof, but do not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

Patent claims

1. Bottle made of plastics, comprising or consisting of cycloolefin copolymer, having a coating of an inorganic-organic hybrid polymer (ORMOCER coating).

2. Bottle according to claim 1, the cycloolefin copolymer being a copolymer of ethylene and cycloolefin.

3. Bottle according to claim 2, the ethylene being unsubstituted or substituted.

4. Bottle according to any one of the preceding claims, the cycloolefin being dicyclopentadiene or a dicyclopentadiene derivative.

5. Bottle according to claim 4, the dicyclopentadiene or dicyclopentadiene derivative being unsubstituted or substituted

6. Bottle according to any one of the preceding claims, the plastics comprising or consisting of a mixture of the cycloolefin polymer and a polymer from the group formed by polypropylene, polyvinyl chloride and polyvinylidene chloride.

7. Bottle according to any one of the preceding claims having a hybrid polymer coating, comprising or consisting of
   (i) a hydrolytic condensate, preparable from a silane of the formula R_mSiX_{4-m} having the following meanings:
   R = crosslinkable organic radical
   X = hydrolysable and condensable group
   m = 1 or 2 or 3 (with 1 being preferred)
   with a metal compound,
   (ii) a prepolymer that is crosslinkable with the radicals R of the silane,
   (iii) one or more optional non-crosslinkable organofunctional silane(s) and
   (iv) an optional low-volatility oxide.

8. Bottle according to claim 7, R in the silane formula being a radical from the group formed by alkyl, alkenyl, alkynyl, aryl, arylalkyl, alkylaryl, arylalkenyl, alkenylaryl, arylalkynyl and alkynylaryl and it being possible for those radicals to be inter-

rupted one or more times by an O atom and/or an S atom and/or an N atom and/or by an NH group, or to have a terminal OH, SH or NH_2 group.

9. Bottle according to claim 8, the radicals R in the silane formula being, independently of one another, an unsubstituted radical or a radical substituted by one or more substituents from the group formed by halogen atoms, unsubstituted amino, amide, aldehyde, keto, alkylcarbonyl, carboxy, mercapto, cyano, isocyano, cyanato, isocyanato, hydroxy, alkoxy, alkoxycarbonyl, sulfonic acid, phosphoric acid, acrylic, acryloxy, methacrylic, methacryloxy, glycidyl, glycidyloxy, epoxy and vinyl groups and such groups in substituted form.

10. Bottle according to any one of claims 7 to 9, the radicals X in the silane formula being, independently of one another, alkoxy groups, aryloxy groups, acyloxy groups, alkylcarbonyl groups, alkoxycarbonyl groups, hydroxy groups, halogen, hydrogen or substituted or unsubstituted amino groups.

11. Bottle according to any one of claims 7 to 10, comprising a prepolymer which carries a group R as reactive group, R having a meaning in accordance with any one of claims 7 to 9.

12. Bottle according to claim 11, comprising a prepolymer which carries a group R as reactive group, R in the prepolymer and in the silane having the same meaning.

13. Bottle according to any one of claims 7 to 12, the silane and the prepolymer being a combination as follows:
    (i) silane having epoxy groups with epoxy resin as prepolymer and/or
    (ii) silane having vinyl radicals with prepolymer having crosslinkable double bonds and/or
    (iii) silane having polymerisable double bonds with prepolymer having crosslinkable double bonds and/or
    (iv) mercapto-group-containing silane with prepolymer having crosslinkable double bonds and/or
    (v) isocyanate-group-containing silane with polyol as prepolymer and/or
    (vi) hydroxyl-group-containing silane with isocyanate as prepolymer and/or
    (vii) amino-group-containing silane with epoxy resin as prepolymer.

14. Bottle according to any one of claims 7 to 13, comprising a hydrolytic condensate of an acrylic-group-containing silane and with a prepolymer acrylate.

15. Bottle according to any one of claims 7 to 14, comprising an optional non-crosslinkable organofunctional silane of the formula R'_mSiX_{4-m} having the following meanings:
R' = non-crosslinkable organic radical
X = hydrolysable and condensable group
m = 1 or 2 or 3.

16. Bottle according to claim 15, R' in the silane formula being a radical from the group formed by alkyl, cycloalkyl, aryl, arylalkyl and alkylaryl and it being possible for those radicals to be interrupted one or more times by an O atom and/or an S atom and/or an N atom and/or by an NH group or to have a terminal OH, SH or NH_2 group.

17. Bottle according to claim 15 or 16, the radicals R' in the silane formula being, independently of one another, an unsubstituted radical or a radical substituted by one or more substituents from the group formed by halogen atoms, unsubstituted amide, aldehyde, keto, alkylcarbonyl, carboxy, cyano, alkoxy, alkoxycarbonyl groups and such groups in substituted form.

18. Bottle according to any one of claims 15 to 17, the radicals X in the silane formula being, independently of one another, alkoxy groups, aryloxy groups, alkylcarbonyl groups, alkoxycarbonyl groups, hydroxy groups, halogen, hydrogen or substituted or unsubstituted amino groups.

19. Bottle according to any one of claims 7 to 18, comprising a low-volatility oxide of compounds of elements of main group Ia, IIa, IIIa, IVa and/or Va or of sub-group IIb, IIIb, Vb, VIb, VIIb and/or VIIIb, with the exception of aluminium.

20. Bottle according to claim 19, comprising B_2O_3, P_2O_5 and/or SnO_2.

21. Bottle according to any one of the preceding claims, comprising ABRASIL GA2-30, ABRASIL GA2-35 or ABRASIL VM-26-IPA2 as coating material.

22. Bottle according to any one of the preceding claims, having a cylindrical or prismatic or square shape.

23. Bottle according to any one of the preceding claims, the bottle being an injection bottle, a screw-closure bottle or an ampoule.

24. Bottle according to claim 22 or 23 in the form of an injection bottle or screw-closure bottle having a volume of from 1 to 1000 ml.

25. Bottle according to claim 24 in the form of an injection bottle having a volume of from 2 to 100 ml.

26. Bottle according to claim 22 or 23 in the form of an ampoule having a volume of from 1 to 20 ml.

27. Bottle according to any one of the preceding claims, having a coating having a thickness of from 1 to 100 µm, especially from 2 to 30 µm and preferably from 8 to 20 µm.

28. Bottle according to any one of the preceding claims, filled with a pharmaceutical preparation and closed with a closure.