Claims

1. A process for forming a laminated structure, the process comprising the step of bonding a polymer film to an array of structures disposed on a substrate under conditions to cause the polymer chains in said polymer film to at least partially infiltrate into said array of structures, wherein said conditions are suitable for controlling the degree of infiltration of said polymer chains into said array of structures, and wherein a plurality of cavities are formed between said polymer film and said array of structures during said bonding.

2. The process as claimed in claim 1, comprising the step of imprinting the structures on the substrate before said bonding step.

3. The process as claimed in claim 1, wherein the cavities are defined by enclosed walls for containing a material therein.

4. The process as claimed in claim 1, wherein the cavities have an opening for permitting material to flow therein.

5. The process as claimed in claim 4, wherein the cavities have another opening for permitting material to flow therethrough.

6. The process as claimed in claim 1, comprising the step of selecting a thermoplastic polymer as said polymer film.

7. The process as claimed in claim 6, comprising the step of selecting poly(methyl methacrylate) as said thermoplastic polymer.

8. The process as claimed in claim 1, comprising the step of selecting said condition from a temperature in the range of about 20°C below the glass transition temperature to about 10°C above the glass transition temperature of said thermoplastic polymer.

9. The process as claimed in claim 8, comprising the step of selecting said temperature from the range consisting of 20°C below said glass transition temperature to the glass transition temperature.

10. The process as claimed in any one of the preceding claims, comprising the step of selecting said condition from a pressure selected from the range consisting of 40 bars to 60 bars.

11. The process as claimed in any one of the preceding claims, comprising the step of selecting said condition from a time duration selected from the range consisting of 150 seconds to 300 seconds.

12. The process as claimed in any one of claims 1 to 11, comprising the step of providing an ordered array of structures on a planar substrate.

13. The process as claimed in any one of claims 1 to 12, wherein the plurality of cavities have an ordered pattern throughout the laminated structure.

14. The process as claimed in any one of the preceding claims, wherein said bonding causes said polymer laminate film to infiltrate said array of structures by a distance selected from the range consisting of 1 to 200 microns.

15. The process as claimed in claim 14, wherein the infiltration distance is selected from the range consisting of 10 nm to 20 nm.

16. The process as claimed in claim any one of the preceding claims, comprising the step of selecting the thickness of said polymer laminate film from the range consisting of 10 nm to 10 millimeters.

17. The process as claimed in any one of the preceding claims, comprising the step of selecting said array of structures having a dimension on the nano-scale size range.

18. The process as claimed in any one of claims 2 to 17, wherein the imprinting step comprises nanoimprinting.

19. The process as claimed in any one of claim 1 or claims 3 to 17, comprising, before the bonding step, the step of forming the structures on the substrate using a technique selected from the

group consisting of photolithography, e-beam writing and focused ion-beam writing.

20. The process as claimed in any one of the preceding claims, comprising the step of selecting a thermosetting polymeric substrate as said substrate.

21. The process as claimed in any one of claims 1 to 20, comprising the step of selecting as said substrate, a cross-linked polymer substrate.

22. A laminated structure comprising a polymer film containing polymer chains that are at least partially bonded with an array of structures disposed on a substrate, wherein said polymer film at least partially infiltrates into the array of structures, and wherein a plurality of cavities are provided between said polymer film and said structures.

23. The laminated structure as claimed in claim 22, wherein said polymer film comprises a thermoplastic polymer.

24. The laminated structure as claimed in claim 22 or claim 23, wherein the polymer film infiltrates into the array of structures by a distance selected from the range consisting of 1 to 200 microns.

25. The laminated structure as claimed in claim 24, wherein the infiltration distance is selected from the range consisting of 10 nm to 20 nm.

26. The laminated structure as claimed in any one of claims 22 to 25, wherein the array of structures have a dimension in the nano-scale size range.

27. The laminated structure as claimed in any one of claims 22 to 26, wherein the substrate comprises a thermosetting polymer.

28. The laminated structure as claimed in any one of claims 22 to 27, wherein the substrate is a cross-linked polymer substrate.

29. A photonic crystal comprising a polymer film containing polymer chains that are at least partially bonded with an array of structures disposed on a substrate, wherein said polymer film at least partially infiltrates into the array of structures, and wherein a plurality of cavities are provided between said polymer film and said structures.

Claims

1. A process for forming a laminated structure, the process comprising the step of bonding a polymer film to an array of structures disposed on a substrate under conditions to cause the polymer chains in said polymer film to at least partially infiltrate into said array of structures, wherein said conditions are suitable for controlling the degree of infiltration of said polymer chains into said array of structures, and wherein a plurality of cavities are formed between said polymer film and said array of structures during said bonding.

2. The process as claimed in claim 1, comprising the step of imprinting the structures on the substrate before said bonding step.

3. The process as claimed in claim 1, wherein the cavities are defined by enclosed walls for containing a material therein.

4. The process as claimed in claim 1, wherein the cavities have an opening for permitting material to flow therein.

5. The process as claimed in claim 4, wherein the cavities have another opening for permitting material to flow therethrough.

6. The process as claimed in claim 1, comprising the step of selecting a thermoplastic polymer as said polymer film.

7. The process as claimed in claim 6, comprising the step of selecting poly(methyl methacrylate) as said thermoplastic polymer.

8. The process as claimed in claim 6, comprising the step of selecting said condition from a temperature in the range of about 20°C below the glass transition temperature to about 10°C above the glass transition temperature of said thermoplastic polymer.

9. The process as claimed in claim 8, comprising the step of selecting said temperature from the range consisting of 20°C below said glass transition temperature to the glass transition temperature.

10. The process as claimed in any one of the preceding claims, comprising the step of selecting said condition from a pressure selected from the range consisting of 40 bars to 60 bars.

11. The process as claimed in any one of the preceding claims, comprising the step of selecting said condition from a time duration selected from the range consisting of 150 seconds to 300 seconds.

12. The process as claimed in any one of claims 1 to 11, comprising the step of providing an ordered array of structures on a planar substrate.

13. The process as claimed in any one of claims 1 to 12, wherein the plurality of cavities have an ordered pattern throughout the laminated structure.

14. The process as claimed in any one of the preceding claims, wherein said bonding causes said polymer laminate film to infiltrate said array of structures by a distance selected from the range consisting of 1 nm to 200 microns.

15. The process as claimed in claim 14, wherein the infiltration distance is selected from the range consisting of 10 nm to 20 nm.

16. The process as claimed in any one of the preceding claims, comprising the step of selecting the thickness of said polymer laminate film from the range consisting of 10 nm to 10 millimeters.

17. The process as claimed in any one of the preceding claims, comprising the step of selecting said array of structures having a dimension on the nano-scale size range.

18. The process as claimed in claim 2, wherein the imprinting step comprises nanoimprinting.

19. The process as claimed in claim 1 or claims 3 to 9, comprising, before the bonding step, the step of forming the structures on the substrate using a technique selected from the

group consisting of photolithography, e-beam writing and focused ion-beam writing.

20. The process as claimed in any one of the preceding claims, comprising the step of selecting a thermosetting polymeric substrate as said substrate.

21. The process as claimed in any one of claims 1 to 20, comprising the step of selecting as said substrate, a cross-linked polymer substrate.

22. A laminated structure comprising a polymer film containing polymer chains that are at least partially bonded with an array of structures disposed on a substrate, wherein said polymer film at least partially infiltrates into the array of structures, and wherein a plurality of cavities are provided between said polymer film and said structures.

23. The laminated structure as claimed in claim 22, wherein said polymer film comprises a thermoplastic polymer.

24. The laminated structure as claimed in claim 22 or claim 23, wherein the polymer film infiltrates into the array of structures by a distance selected from the range consisting of 1 nm to 200 microns.

25. The laminated structure as claimed in claim 24, wherein the infiltration distance is selected from the range consisting of 10 nm to 20 nm.

26. The laminated structure as claimed in any one of claims 22 to 25, wherein the array of structures have a dimension in the nano-scale size range.

27. The laminated structure as claimed in any one of claims 22 to 26, wherein the substrate comprises a thermosetting polymer.

28. The laminated structure as claimed in any one of claims 22 to 27, wherein the substrate is a cross-linked polymer substrate.

29. A photonic crystal comprising a polymer film containing polymer chains that are at least partially bonded with an array of structures disposed on a substrate, wherein said polymer film at least partially infiltrates into the array of structures, and wherein a plurality of cavities are provided between said polymer film and said structures.