Claims

1. A textured polymer substrate comprising at least one polymer substrate surface, wherein said polymer substrate surface comprises an array of micro-sized structures integrally formed on said polymer substrate, wherein each micro-sized structure has at least one surface with nano-sized surface features imprinted thereon, said polymer substrate surface having at least one amorphous oxide layer deposited thereon, wherein said amorphous oxide layer comprises an oxide of a metal selected from titanium, cobalt, aluminum and composites thereof.

2. The textured polymer substrate of claim 1, wherein said nano-sized surface features are formed on a hierarchical array.

3. The textured polymer substrate of claim 1, wherein said micro-sized structures are geometrically selected to be biomimetic.

4. The textured polymer substrate of claim 1, wherein said array of micro-sized structures comprises tessellated structures selected from the group consisting of: trigonal, tetragonal, square, rhombic, pentagonal, hexagonal, heptagonal, octagonal, nonagonal, decagonal, undecagonal, dodecagonal, tridecagonal and tetreadecagonal structures.

5. The textured polymer substrate of claim 1 or claim 4, wherein said array of micro-sized structures comprises ommatidium or ommatidia-like structures.

6. The textured polymer substrate of claim 1, wherein said micro-sized structures comprise at least one diameter dimension of between about 1 to about 15 microns.

7. The textured polymer substrate of any one of the preceding claims, wherein at least a height dimension, or at least a width dimension, or both, of said nano-sized surface features is lesser than 390 to 700 nm.

8. The textured polymer substrate of any one of the preceding claims, wherein said amorphous oxide layer has a substantially uniform thickness deposited by a chemical vapor deposition process, characterized in that said process is performed at a temperature below the glass transition temperature of said polymer substrate.

9. The textured polymer substrate of any one of the preceding claims, wherein said amorphous oxide layer is deposited by Atomic Layer Deposition.

10. The textured polymer substrate of any one of the preceding claims, wherein said polymer substrate is substantially optically transparent.

11. The textured polymer substrate of any one of the preceding claims, wherein said amorphous oxide layer comprises amorphous titanium oxide.

12. A method of preparing a polymer substrate, said method comprising the steps of:

imprinting a surface of said polymer substrate with a patterned mold to integrally form a patterned surface having an array of micro-sized structures;

embossing said patterned surface to form a hierarchical array, wherein nano-sized surface features are integrally formed on a surface of said micro-sized structures; and

depositing an amorphous oxide layer over said polymer substrate surface, wherein said amorphous oxide layer comprises an oxide of a metal selected from titanium, cobalt, aluminum and composites thereof.

13. The method of claim 12, wherein said depositing step comprises atomic layer deposition.

14. The method of claim 12 or 13, wherein said imprinting step is performed at a temperature above the glass transition temperature of said polymer substrate.

15. The method of any one of claims 12 to 14, wherein said embossing step is performed at a temperature lower than the glass transition temperature of said polymer substrate.

16. The method of any one of claims 12 to 15, wherein the mold of said imprinting step is selected to provide tesallated polygonal structures on said patterned surface;
wherein said polygonal structures are micro-sized structures.

17. The method of claim 16, wherein said embossing step comprises contacting at least a surface of said micro-sized polygonal structures with a second mold to integrally form a plurality of nano-sized surface features, thereby forming a hierarchical array.

18. The method of claim 17, wherein the nano-sized surface features comprises structures selected from the group consisting of: nano-cones, nano-pyramids, nano-cylinders, nano-needles, nano-blades, and combinations thereof.

19. The method of any one of claims 12 to 18, wherein said amorphous oxide layer is amorphous titanium oxide.

20. The method of claim 19, wherein said deposition step is undertaken to obtain a thickness of said amorphous titanium oxide layer of from about 10 to 50 nm.