Claims

1. A process for fabricating an ion-implanted layer in a substrate comprising: ablating a target material with incident radiation from a laser in the presence of the substrate and in the presence of a gas at a pressure within the range 72mTorr to 99mTorr, thereby implanting a quantity of the target material into the substrate to form said ion implanted layer such that the penetration depth of the implanted ions is at least 50nmsubstrate comprising an ion-implanted layer wherein the penetration depth of the implanted ions is at least 50nm, or at least 200nm.

2. A process according to any preceding claim wherein said ion implanted layer has a substantially uniform distribution of the implanted ions substantially from the surface of the substratesubstrate according to Claim 1 where the penetration depth of the implanted ions is at least 500nm.

3. A process according to any preceding claim wherein said ion implanted layer has an implanted ion density of at least 10^{21} ions cm^{-3}, or at least 10^{23} ions cm^{-3}substrate comprising an ion-implanted layer wherein the ion implanted layer has a substantially uniform distribution of the implanted ions.

4. A process according to any preceding claim wherein the process is carried out at a partial pressure within the range 80mTorr to 90mTorr.

5. A process according to any preceding claim wherein the substrate is spaced from the target material by a distance in the range 0mm to 68.6mm.

6. A process according to any preceding claim wherein the substrate is spaced from the target material by a distance in the range 45mm to 68.6mm.

7. A process according to any preceding claim wherein the substrate is spaced from the target material by a distance in the range 71.4mm to 165mm.

4. A substrate comprising an ion-implanted layer wherein the ion implanted layer has an implanted ion density of at least 10^{21} ions cm^{-3}, or at least 10^{23} ions cm^{-3}.

5. A substrate according any one of the preceding claims wherein the substrate is a glass selected from silica, silicate, phosphate, tellurite, tellurite derivatives, germanate, bismuthate and solgel route glasses.

6. A substrate according any one of Claims 1 to 4 wherein the substrate is an optical polymer.

7. A substrate according to Claim 6 wherein the optical polymer is selected from Poly(methyl methacrylate), polyvinyl alcohol, polyether ether ketone, polyethylene terephthalate, polyimide, polypropylene, and polytetrafluoroethylene.

8. A substrate according to any one of the preceding claims wherein the ion-implanted layer is either:
(i) on an outside face of the substrate; or
(ii) within the substrate.

9. A substrate according to any one of the preceding claims wherein the ion-implanted layer either:
(i) encompasses substantially the whole area of the substrate; or
(ii) comprises one or more zones.

10. A substrate according to Claim 9 wherein one or more of the zones overlap.

11. A substrate according to Claim 9 or Claim 10 wherein the zones comprise the same or different ions.

12. A substrate according to any one of Claims 1 to 11 wherein the ion is a cation.

13. A substrate according to Claim 12 wherein the cation is selected from the group Nd(3+), Yb(3+), Er(3+), Tm(3+), Pr(3+), Ho(3+), Sm(3+), Eu(3+), Tb(3+), Ce(3+) and La (3+).

14. A waveguide comprising a substrate according to any one of claims 1 to 13.

15. A biosensor comprising an optical substrate any of claims 1 to 13 or a waveguide according to Claim 14.

16. A method for the non-invasive measurement of a metabolite in an animal which comprises:
(i) applying a sensor on or near said animal, for example applying said sensor to the skin of the animal, said sensor comprising an optical substrate or waveguide;
(ii) irradiating said substrate or waveguide with a light source, for example, a laser, such that a portion of the light escapes into the animal;
(iii) measuring the photoluminescence lifetime of the escaped light;

~~wherein the recovery lifetime is correlated with the level of the metabolite.~~

~~17. A process for fabricating a substrate according to any one of Claims 1 to 13 comprising: ablating a target layer with incident radiation from a laser (e.g. an ultrafast laser) in the presence of a substrate whereby a quantity of the target layer is implanted into the substrate.~~

~~18.~~ A process according to any preceding claim wherein the target material is tellurium-based glass~~process according to Claim 17 wherein the target layer is tellurium glass.~~

~~19.~~ A process according to any preceding claim wherein the substrate is heated~~process according to Claim 18 or 19 wherein the laser (e.g. ultrafast laser) is a Femtosecond laser.~~

~~20. A process according to Claim 18, 19 or 20 wherein the substrate is heated.~~

10. A substrate comprising an ion-implanted layer wherein the penetration depth of the implanted ions is at least 50nm and wherein the ion implanted layer has a substantially uniform distribution of the implanted ions substantially from the surface of the substrate.

11. A substrate according to claim 10 wherein the penetration depth of the implanted ions is at least 200nm.

12. A substrate according to claim 10 where the penetration depth of the implanted ions is at least 500nm.

13. A substrate according to any of claims 10 to 12 wherein the ion implanted layer has an implanted ion density of at least 1021 ions cm-3, or at least 1023 ions cm-3.

14. A substrate according any one of claims 10 to 13 wherein the substrate is a glass selected from silica, silicate, phosphate, tellurite, tellurite derivatives, germanate, bismuthate and solgel route glasses.

15. A substrate according any one of claims 10 to 14 wherein the substrate is an optical polymer.

16. A substrate according to claim 15 wherein the optical polymer is selected from Poly(methyl methacrylate), polyvinyl alcohol, polyether ether ketone, polyethylene terephthalate, polyimide, polypropylene, and polytetrafluoroethylene.

17. A substrate according to any one of claims 10 to 16 wherein the ion-implanted layer is either:
(i) on an outside face of the substrate; or
(ii) within the substrate.

18. A substrate according to any one of claims 10 to 17 wherein the ion-implanted layer either:
(i) encompasses substantially the whole area of the substrate; or
(ii) comprises one or more zones.

19. A substrate according to claim 18 wherein one or more of the zones overlap.

20. A substrate according to claim 18 or claim 19 wherein the zones comprise the same or different ions.

21. A substrate according to any one of claims 10 to 20 wherein the ion is a cation.

22. A substrate according to claim 21 wherein the cation is selected from the group Nd(3+), Yb(3+), Er(3+), Tm(3+), Pr(3+), Ho(3+), Sm(3+), Eu(3+), Tb(3+), Ce(3+) and La (3+).

23. A waveguide comprising a substrate according to any one of claims 10 to 22.

24. A biosensor comprising an optical substrate any of claims 10 to 22 or a waveguide according to Claim 23.

25. A method for the non-invasive measurement of a metabolite in an animal which comprises:
(i) applying a sensor on or near said animal, for example applying said sensor to the skin of the animal, said sensor comprising an optical substrate or waveguide;
(ii) irradiating said substrate or waveguide with a light source, for example, a laser, such that a portion of the light escapes into the animal;
(iii) measuring the photoluminescence lifetime of the escaped light;
wherein the recovery lifetime is correlated with the level of the metabolite.