What is Claimed is:

1. A method for controllably bonding a substrate to a carrier, comprising:

obtaining a substrate having a polymer bonding surface, the polymer bonding surface having a first surface energy;

obtaining a carrier having a glass bonding surface, the glass bonding surface having a second surface energy;

depositing a surface modification layer onto the glass bonding surface so as to decrease the surface energy of the glass bonding surface; and

bonding the polymer bonding surface to the glass bonding surface via the surface modification layer, wherein the substrate is non-destructively debondable from the carrier after being subjected to a one hour vacuum anneal in an environment having a temperature of 120°C.

2. The method of claim 1, wherein the surface modification layer is deposited by one of:

plasma polymerization of a carbon-containing gas;

plasma polymerization of a hydrocarbon-containing gas;

plasma polymerization of hydrocarbon-containing and fluorocarbon-containing gases;

plasma polymerization of hydrocarbon-containing and hydrogen-containing gasses;

plasma polymerization of a hydrocarbon-containing gas to form a layer followed by treatment of the layer with a nitrogen-containing gas;

plasma polymerization of a hydrocarbon-containing gas to form a layer followed by sequential treatment of the layer by two separate gasses, wherein one gas contains nitrogen and the other gas contains hydrogen;

plasma polymerization of a hydrocarbon-containing gas to form a layer followed by sequential treatment of the layer by two separate gasses, wherein one gas contains nitrogen and oxygen, and the other gas contains nitrogen;

plasma polymerization of a hydrocarbon-containing gas to form a layer followed by treatment of the layer with a nitrogen-and-oxygen-containing gas;

plasma polymerization of hydrocarbon-containing, nitrogen-containing, and hydrogen-containing, gasses;

plasma polymerization of a hydrocarbon-containing and hydrogen containing gasses to form a layer followed by treatment of the layer with nitrogen-containing gas;

plasma polymerization of a fluorocarbon-containing gas;

plasma polymerization of fluorocarbon-containing and hydrogen-containing gasses; and

plasma polymerization of a fluorocarbon-containing gas to form a layer, followed by simultaneous treatment of the layer with nitrogen-containing, and hydrogen-containing, gasses.

3. The method of claim 1, wherein the surface modification layer is deposited by plasma polymerization of methane, ammonia, and hydrogen, gasses.

4. The method of claim 1, wherein the surface modification layer has a thickness of from 1 to 70 nm.

5. The method of claim 1, further comprising:

cleaning the polymer bonding surface so as to provide the first surface energy.

6. The method of claim 1, wherein the substrate is a composite comprising polymer and glass.

7. The method of claim 1, wherein the glass bonding surface prior to deposition of the surface modification layer has an average surface roughness Ra of ≤ 1 nm.

8. The method of claim 1, wherein the substrate has a thickness of ≤ 300 microns.

9. An article comprising:

a substrate having a polymer bonding surface;

a carrier having a glass bonding surface;

a plasma-polymerized surface modification layer releasably bonding the polymer bonding surface to the glass bonding surface.

10. The article of claim 9, wherein the surface modification layer has a thickness of from 1 to 70 nm.

11. The article of claim 9, wherein the surface modification layer comprises at least one of:

a plasma-polymerized hydrocarbon; and

a plasma polymerized fluorocarbon.

12. The article of claim 9, wherein the substrate is a composite comprising polymer and glass.

13. The article of claim 9, wherein the glass bonding surface has an average surface roughness Ra of ≤ 1 nm without the surface modification layer disposed thereon.

14. The article of claim 9, wherein the substrate has a thickness of ≤ 300 microns.

What is claimed is:

1. A method for controllably bonding a substrate to a carrier, comprising:

obtaining a substrate having a polymer bonding surface, the polymer bonding surface having a first surface energy;

obtaining a carrier having a glass bonding surface, the glass bonding surface having a second surface energy;

depositing a surface modification layer onto the glass bonding surface so as to decrease the surface energy of the glass bonding surface; and

bonding the polymer bonding surface to the glass bonding surface via the surface modification layer, wherein the substrate is non-destructively debondable from the carrier after being subjected to a one hour vacuum anneal in an environment having a temperature of 120°C.

2. The method of claim 1, wherein the surface modification layer is deposited by one of:

plasma polymerization of a carbon-containing gas;

plasma polymerization of a hydrocarbon-containing gas;

plasma polymerization of hydrocarbon-containing and fluorocarbon-containing gases;

plasma polymerization of hydrocarbon-containing and hydrogen-containing gasses;

plasma polymerization of a hydrocarbon-containing gas to form a layer followed by treatment of the layer with a nitrogen-containing gas;

plasma polymerization of a hydrocarbon-containing gas to form a layer followed by sequential treatment of the layer by two separate gasses, wherein one gas contains nitrogen and the other gas contains hydrogen;

plasma polymerization of a hydrocarbon-containing gas to form a layer followed by sequential treatment of the layer by two separate gasses, wherein one gas contains nitrogen and oxygen, and the other gas contains nitrogen;

plasma polymerization of a hydrocarbon-containing gas to form a layer followed by treatment of the layer with a nitrogen-and-oxygen-containing gas;

plasma polymerization of hydrocarbon-containing, nitrogen-containing, and hydrogen-containing, gasses;

plasma polymerization of a hydrocarbon-containing and hydrogen containing gasses to form a layer followed by treatment of the layer with nitrogen-containing gas;

plasma polymerization of a fluorocarbon-containing gas;

plasma polymerization of fluorocarbon-containing and hydrogen-containing gasses; and

plasma polymerization of a fluorocarbon-containing gas to form a layer, followed by simultaneous treatment of the layer with nitrogen-containing, and hydrogen-containing, gasses.

3. The method of claim 1 or claim 2, wherein the surface modification layer has a thickness of from 1 to 70 nm.

4. The method of any one of claims 1-3, further comprising:

cleaning the polymer bonding surface so as to provide the first surface energy.

5. The method of any one of claims 1-4, wherein the glass bonding surface prior to deposition of the surface modification layer has an average surface roughness Ra of $\leq$ 1 nm.

6. The method of any one of claims 1-5, wherein the substrate has a thickness of $\leq$ 300 microns.

7. An article comprising:

a substrate having a polymer bonding surface;

a carrier having a glass bonding surface;

a plasma-polymerized surface modification layer releasably bonding the polymer bonding surface to the glass bonding surface.

8. The article of claim 7, wherein the surface modification layer has a thickness of from 1 to 70 nm.

9. The article of claim 7 or claim 8, wherein the glass bonding surface has an average surface roughness Ra of $\leq$ 1 nm without the surface modification layer disposed thereon.

10. The article of any one of claims 7-9, wherein the substrate has a thickness of $\leq$ 300 microns.