CLAIMS

1. A bonding sheet for use with semiconductor components, the bonding sheet comprising:

a first side configured to be attached to a first semiconductor component;

a second side configured to be attached to a second semiconductor component;

an etch resistant material disposed in first regions of the bonding sheet;

a bond material disposed in second regions of the bonding sheet; and

a plurality of thermal conductive elements embedded within the bond material in the second regions,

wherein individual first regions are distinct from and positioned proximate to individual second regions; and

wherein the bonding sheet has:

a thickness less than about 200 microns,

a flatness across a length of the bonding sheet less than about 20 microns, and

an elongation specification less than about 20%.

2. The bonding sheet of claim 1 wherein the thermal conductivity elements are configured to decompose into a gas when exposed to plasma processes.

3. The bonding sheet of claim 1 wherein:

the bond material comprises at least one of polydimethylsiloxane (PDMS) and fluoroelastomers (FKM),

the etch resistant material comprises polyetheretherketone (PEEK), and

the thermal conductivity elements comprise organic fillers configured to decompose into a gas when exposed to plasma processes.

4. The bonding sheet of claim 1, further comprising:

a thermal conductivity less than about 0.3 W/m·K, and

a thermal uniformity such that a temperature differential across a surface of the bonding sheet is equal to or less than about 2°C within a temperature range from about -60°C to about 180°C.

5. The bonding sheet of claim 1 wherein the bond material comprises polydimethylsiloxane (PDMS).

6. The bonding sheet of claim 1 wherein the bond material comprises a fluoroelastomer (FKM).

7. The bonding sheet of claim 1 wherein the first regions correspond to openings in the bonding sheet filled with the etch resistant material, wherein diameters of at least a portion of the openings differ from one another, and wherein at least a portion of the openings are configured to be positioned to be aligned with a plurality of features on the first semiconductor components, the second semiconductor components, or both.

8. The bonding sheet of claim 1 wherein the thermal conductivity elements comprise particles suspended in the bond material, the particles comprising at least one of silica particles and boron nitride (BN).

9. The bonding sheet of claim 8 wherein the thermal conductivity elements comprise at least about 20% of the bond material of the bonding sheet.

10. The bonding sheet of claim 1 wherein the etch resistant material comprises polyetheretherketone (PEEK).

11. The bonding sheet of claim 10 wherein the etch resistant material comprises a plasma-resistant coating including at least one of yttrium oxide (Y_2O_3), yttrium fluoride (YF_3), and yttrium oxyfluoride (YOF).

12. The bonding sheet of claim 1 wherein each of the first and second regions extend through the entire bonding sheet from the first side to the second side, and wherein an outermost surface of the bonding sheet alternates between the etch resistant material and the bond material.

13. The bonding sheet of claim 1, further comprising one or more adhesion promoters in the bonding material configured to inhibit polymerization or cross-linking of the bond material.

14. A device for attaching one or more semiconductor components to one another, the device comprising:

a bonding sheet including—

a first side configured to be attached to a first semiconductor component,

a second side opposite the first side and configured to be attached to a second semiconductor component,

a bond material spanning substantially across a thickness of the bonding sheet, wherein the bond material comprises perfluoro-elastomers (FFKM);

an etch resistant material disposed in openings extending through the bonding sheet from the first side to the second side; and

a plurality of thermal conductivity elements embedded in the bond material, the thermal conductivity elements being configured to decompose into a gas when exposed to plasma processing.

15. The device of claim 14 wherein:

the etch resistant material is disposed in first regions of the bonding sheet, and

the bond material is disposed in second regions of the bonding sheet distinct from the first regions, the second regions comprising the openings.

16. The device of claim 14 wherein:

the bond material comprises at least one of polydimethylsiloxane (PDMS) and fluoroelastomers (FKM),

the etch resistant material comprises polyetheretherketone (PEEK), and

the thermal conductivity elements comprise organic fillers.

17. The device of claim 14 wherein the thickness is less than about 200 microns,
a conductivity less than about 0.3 W/m·K,
a flatness across a length of the bonding sheet less than about 20 microns, and
an elongation specification less than about 20%.

18. A bonding sheet for use with semiconductor components, the bonding sheet comprising:
a first side configured to be attached to a first semiconductor component;
a second side configured to be attached to a second semiconductor component;
an etch resistant material disposed in first regions of the bonding sheet;
a bond material disposed in second regions of the bonding sheet; ~~and~~
a plurality of thermal conductive elements embedded within the bond material in the second regions,
a thermal conductivity less than about 0.3 W/m·K, and
a thermal uniformity such that a temperature differential across a surface of the bonding sheet is equal to or less than about 2°C within a temperature range from about -60°C to about 180°C;
wherein individual first regions are distinct from and positioned proximate to individual second regions.

19. A bonding sheet for use with semiconductor components, the bonding sheet comprising:
a first side configured to be attached to a first semiconductor component;
a second side configured to be attached to a second semiconductor component;
an etch resistant material disposed in first regions of the bonding sheet, wherein the etch resistant material comprises polyetheretherketone (PEEK) and the etch resistant material comprises a plasma-resistant coating including at least one of yttrium oxide (Y_2O_3), yttrium fluoride (YF_3), and yttrium oxyfluoride (YOF);
a bond material disposed in second regions of the bonding sheet; and

a plurality of thermal conductive elements embedded within the bond material in the second regions,

wherein individual first regions are distinct from and positioned proximate to individual second regions.

20. A device for attaching one or more semiconductor components to one another, the device comprising:

a bonding sheet including—

a first side configured to be attached to a first semiconductor component,

a second side opposite the first side and configured to be attached to a second semiconductor component,

a bond material spanning substantially across a thickness of the bonding sheet;

an etch resistant material disposed in openings extending through the bonding sheet from the first side to the second side; and

a plurality of thermal conductivity elements embedded in the bond material, the thermal conductivity elements being configured to decompose into a gas when exposed to plasma processing;

wherein the thickness is less than about 200 microns,

a thermal conductivity less than about 0.3 W/m·K,

a flatness across a length of the bonding sheet is less than about 20 microns, and

an elongation specification less than about 20%.