What is claimed is:

1. An underfill structure comprising in order: a top film layer; a polymer layer, and a bottom film layer, wherein the polymer layer comprises a first polymer region and a second polymer region, wherein the second polymer region comprises inorganic filler.

2. The underfill structure of claim 1 wherein the second polymer region further comprises a layer comprising a curable polymer, crosslinking agent, and curing agent.

3. The underfill structure of claim 1 wherein the inorganic filler is present in the second polymer region in an amount of $\geq$ 40 wt%, based on the total weight of the second polymer region.

4. The underfill structure of claim 1 wherein an adhesive layer is disposed between the top film layer and the polymer layer.

5. The underfill structure of claim 1 wherein the top film layer is composed of an elastomer.

6. The underfill structure of claim 1 wherein the top film layer is a polymer chosen from polyolefins, polyesters, polyurethanes, poly(vinyl chloride), poly(vinylidene chloride), ethylene vinyl acetate, and poly(meth)acrylates.

7. The underfill structure of claim 1 wherein the bottom film layer is chosen from polyester, polyamide, polyimide, polyolefin, polyacrylate, polyurethane, and metal.

8. The underfill structure of claim 1 wherein the first polymer region comprises a curable polymer, crosslinking agent, and curing agent.

9. The underfill structure of claim 8 wherein the first polymer region further comprises inorganic filler in an amount that is less than the amount of inorganic filler in the second polymer region.

10. The underfill structure of claim 8 wherein the first polymer region is free of inorganic filler.

11. A method comprising:

providing the underfill structure of claim 1;

removing the bottom film from the underfill structure;

laminating the underfill structure to a surface of a component having interconnect structures thereon, such that the underfill structure is forced between interconnect structures, wherein the height of the second polymer region is less than or equal to the height of the interconnect structures; and

removing the top film layer.

12. The method of claim 11 further comprising: registering a top portion of the interconnect structures with conductive bond pads on a surface of a substrate to form a unit; and causing the interconnect structures to electrically connect the interconnect structures to the conductive bond pads.

13. A method comprising: providing the underfill structure described above; removing the bottom film from the underfill structure; laminating the underfill structure to a surface of a substrate having conductive bond pads such that the first polymer region is directly on the surface of the substrate; and removing the top film layer.

14. The method of claim 13 further comprising: registering the conductive bond pads with interconnect structures on a surface of a component to form a unit; and heating the unit to melt the interconnect structures to electrically connect the interconnect structures with the conductive bond pads.

Claims

1. An underfill structure comprising in order: a removable top film layer; a removable buffer layer, a polymer layer, and a removable bottom film layer, wherein the polymer layer comprises a first polymer region on a second polymer region or a second polymer region on a first polymer region, wherein the second polymer region comprises non-conductive inorganic filler, and wherein the first polymer region is formed from a polymer that functions as a fluxing agent..

2. The underfill structure of claim 1 wherein the second polymer region further comprises a layer comprising a curable polymer, crosslinking agent, and curing agent.

3. The underfill structure of claim 1 wherein the non-conductive inorganic filler is present in the second polymer region in an amount of ≥40 wt%, based on the total weight of the second polymer region.

4. The underfill structure of claim 1 wherein the buffer layer is an adhesive material.

5. The underfill structure of claim 1 wherein the top film layer is composed of an elastomer.

6. The underfill structure of claim 1 wherein the top film layer is a polymer chosen from polyolefins, polyesters, polyurethanes, poly(vinyl chloride), poly(vinylidene chloride), ethylene vinyl acetate, and poly(meth)acrylates.

7. The underfill structure of claim 1 wherein the bottom film layer is chosen from polyester, polyamide, polyimide, polyolefin, polyacrylate, polyurethane, and metal.

8. The underfill structure of claim 1 wherein the first polymer region comprises a curable polymer, crosslinking agent, and curing agent.

9. The underfill structure of claim 8 wherein the first polymer region further comprises non-conductive inorganic filler in an amount that is less than the amount of non-conductive inorganic filler in the second polymer region.

10. The underfill structure of claim 8 wherein the first polymer region is free of inorganic filler.

11. A method comprising:

providing the underfill structure of claim 1;

removing the bottom film from the underfill structure;

laminating the underfill structure to a surface of a component having interconnect structures thereon, such that the underfill structure is forced between interconnect structures, wherein the height of the second polymer region is less than or equal to the height of the interconnect structures; and

removing the top film layer.

12. The method of claim 11 further comprising: registering a top portion of the interconnect structures with conductive bond pads on a surface of a substrate to form a unit; and causing the interconnect structures to electrically connect the interconnect structures to the conductive bond pads.

13. A method comprising: providing the underfill structure described above; removing the bottom film from the underfill structure; laminating the underfill structure to a surface of a substrate having conductive bond pads such that the first polymer region is directly on the surface of the substrate; and removing the top film layer.

14. The method of claim 13 further comprising: registering the conductive bond pads with interconnect structures on a surface of a component to form a unit; and heating the unit to melt the interconnect structures to electrically connect the interconnect structures with the conductive bond pads.

15. The underfill structure of claim 1 wherein the first polymer region and the second polymer region form a unitary polymer region upon heating.