

Claims:

1. A method for cleaning a pick-and-place apparatus of a semiconductor device handling machine that is used for packaged semiconductor device testing, the method comprising:

5 positioning an elastomeric cleaning material near a pick-and-place apparatus connected to a semiconductor device handling machine, the pick-and-place apparatus having one of a vacuum aperture, a nozzle, a suction cup, a suction inlet, a vacuum collet, and a vacuum pick-up tool wherein each has an inner surface and an outer surface;

10 inserting, while the pick-and-place apparatus remains attached to the semiconductor device handling machine, the pick-and-place apparatus onto and into the elastomeric cleaning material so that one of the vacuum aperture, the nozzle, the suction cup, the suction inlet, the vacuum collet and the vacuum pick-up tool contact the elastomeric cleaning material; and

removing debris from the inner surface and outer surface of one of the vacuum aperture, the nozzle, the suction cup, the suction inlet, the vacuum collet and the vacuum pick-up tool.

15 2. The method of claim 1 further comprising moving the elastomeric cleaning material adjacent to the pick-and-place apparatus.

3. The method of claim 1 further comprising trapping the debris within the elastomeric cleaning material.

4. The method of claim 1, wherein the elastomeric cleaning device has a cross linked polymer layer.

20 5. The method of claim 4, wherein the elastomeric cleaning material further comprises one or more intermediate layers having predetermined characteristics underneath the cross linked polymer layer.

25 6. The method of claim 1, wherein positioning the elastomeric cleaning material further comprises using the semiconductor device handling machine to position the elastomeric cleaning material and to move a plurality of semiconductor devices during a package test process.

7. The method of claim 5, wherein the elastomeric cleaning material further comprises a carrier underneath the one or more intermediate layers.

8. The method of claim 7, wherein the elastomeric cleaning material has a specific gravity, an elasticity, a tackiness, a thickness and a porosity.

9. A method for cleaning a pick-and-place apparatus of a surface mount technology (SMT) component placement machine, the method , comprising:

positioning an elastomeric cleaning material near a pick-and-place apparatus connected to a SMT machine, the pick-and-place apparatus having one of a vacuum aperture, a nozzle, a suction cup, a suction inlet, a vacuum collet, and a vacuum pick-up tool; and

inserting, while the pick-and-place apparatus remains attached to the SMT machine, the pick-and-place apparatus onto and into the elastomeric cleaning material so that one of the vacuum aperture, the nozzle, the suction cup, the suction inlet, the vacuum collet and the vacuum pick-up tool contact the elastomeric cleaning material that removes debris from one or more surfaces of one or more of the vacuum aperture, the nozzle, suction cup, the suction inlet, the vacuum collet, and the vacuum pick-up tool.

10. The method of claim 9 further comprising moving the elastomeric cleaning material adjacent to the pick-and-place apparatus.

11. The method of claim 9 further comprising trapping the debris within the elastomeric cleaning material.

12. The method of claim 9, wherein the elastomeric cleaning device has a cross linked polymer layer.

13. The method of claim 12, wherein the elastomeric cleaning material further comprises one or more intermediate layers having predetermined characteristics underneath the cross linked polymer layer.

14. The method of claim 9, wherein positioning the elastomeric cleaning material further comprises using the semiconductor device handling machine to position the elastomeric cleaning material and to move a plurality of semiconductor devices during a printed circuit board assembly process.

15. The method of claim 13, wherein the elastomeric cleaning material further comprises a carrier underneath the one or more intermediate layers.

16. The method of claim 15, wherein the elastomeric cleaning material has a specific gravity, an elasticity, a tackiness, a thickness and a porosity.

17. A method for cleaning a pick-and-place apparatus of a die attach or a flip chip bonder machine, the method , comprising:

positioning an elastomeric cleaning material near a pick-and-place apparatus connected to a die attach or a flip chip bonder machine, the pick-and-place apparatus having one of a vacuum aperture, a nozzle, a suction cup, a suction inlet, a vacuum collet, and a vacuum pick-up tool, wherein each has an inner surface and an outer surface;

5 inserting, while the pick-and-place apparatus remains attached to the die attach or a flip chip bonder machine, the pick-and-place apparatus onto and into the elastomeric cleaning material so that one of the vacuum aperture, the nozzle, the suction cup, the suction inlet, the vacuum collet and the vacuum pick-up tool contact the elastomeric cleaning material; and

 removing debris from the inner surface and outer surface of one of the vacuum aperture,
10 the nozzle, the suction cup, the suction inlet, the vacuum collet and the vacuum pick-up tool.

 18. The method of claim 17 further comprising moving the elastomeric cleaning material adjacent to the pick-and-place apparatus.

 19. The method of claim 17 further comprising trapping the debris within the elastomeric cleaning material.

15 20. The method of claim 17, wherein the elastomeric cleaning device has a cross linked polymer layer.

 21. The method of claim 20, wherein the elastomeric cleaning material further comprises one or more intermediate layers having predetermined characteristics underneath the cross linked polymer layer.

20 22. The method of claim 17, wherein positioning the elastomeric cleaning material further comprises using the semiconductor device handling machine to position the elastomeric cleaning material and to move a plurality of semiconductor devices during a printed circuit board assembly process.

 23. The method of claim 22, wherein the elastomeric cleaning material further
25 comprises a carrier underneath the one or more intermediate layers.

 24. The method of claim 23, wherein the elastomeric cleaning material has a specific gravity, an elasticity, a tackiness, a thickness and a porosity.

 25. An apparatus, comprising:

a semiconductor device handling machine having a pick and place apparatus, the pick and place apparatus having a contact element with an inner surface and an outer surface and the contact element contacts and picks one of a device and a component using suction;

5 a cleaning material attached to a substrate that is positioned adjacent to the pick and place apparatus, the cleaning material having a top layer that is contacted by the contact element of the pick and place apparatus during a cleaning process wherein the top layer has a characteristics that cleans an inside and outside surface of the contact element; and

wherein the contact element is cleaned while the contact element is attached to the pick and place apparatus by inserting an end of the contact element into a cleaning material; and

10 wherein the pick and place apparatus performs a pick and place operation once the contact element is cleaned.

26. The apparatus of claim 25, wherein the cleaning material further comprises a surface tackiness that causes a piece of debris on the contact element to transfer to the cleaning material.

15 27. The apparatus of claim 26, wherein the surface tackiness is in a range between 20 grams and 800 grams.

28. The apparatus of claim 25, wherein the cleaning material further comprises a cleaning pad layer that has one or more microfeatures formed in the cleaning pad layer.

20 29. The apparatus of claim 28, wherein the one or more microfeatures are one of microcolumns and micropyramids.

30. The apparatus of claim 28, wherein the cleaning material further comprises one or more intermediate layers underneath the cleaning pad layer that support the cleaning pad layer.

31. The apparatus of claim 30, wherein the intermediate layers are one of rigid layers, compliant layers and rigid and compliant layers.

25 32. The apparatus of claim 30, wherein the cleaning material further comprises a release layer on top of a top surface of the cleaning pad layer that protects the cleaning pad layer.

33. The apparatus of claim 25, wherein the cleaning material further comprises a substrate on top of which a cleaning pad layer is supported.

34. The apparatus of claim 25, wherein the pick and place apparatus further comprises one of a pick and place apparatus for a packaged device being tested and a pick and place apparatus for a component used in a surface mount process.

5 35. The apparatus of claim 25, wherein the pick and place apparatus further comprises one of a pick and place apparatus for a die attach machine and a pick and place apparatus for a flip-chip bonder machine.

36. The apparatus of claim 25, wherein the contact element further comprises one of a vacuum aperture, a nozzle, a suction cup, a suction inlet, a vacuum collet of the pick and place apparatus.

10 37. The apparatus of claim 25, wherein the top surface of the cleaning material is a textured surface that cleans an inside surface and an outside surface of the vacuum pickup tool.

38. The apparatus of claim 25, wherein the cleaning layer has a set of microfeatures having a spacing, a moment of inertia and a total length of each microfeature determined based on at least a diameter of the content element of the pick and place apparatus.

15 39. The apparatus of claim 25, wherein the cleaning layer has a set of microfeatures and an array of streets, avenues or diagonals that decouple each microfeature from each other microfeature and a width of each street, avenue or diagonal is based on a dimension of the content element of the pick and place apparatus.

20 40. A cleaning device, comprising:
a cleaning material attached to a substrate;
the cleaning material being a polymer and having a set of microfeatures that are configured to clean a contact element of a pick and place machine that has an inner surface and an outer surface; and

25 wherein a top surface of the cleaning material has a surface tackiness that causes a piece of debris on the contact element surface to transfer to the cleaning material and a characteristic that cleans the inner and outer surface of the contact element.

41. The cleaning device of claim 40, wherein the surface tackiness is in a range between 20 grams and 800 grams.

30 42. The cleaning device of claim 41, wherein the set of microfeatures are one of microcolumns and micropyramids.

43. The cleaning device of claim 40, wherein the cleaning material further comprises a cleaning pad layer and one or more intermediate layers underneath the cleaning pad layer that support the cleaning pad layer.

44. The cleaning device of claim 43, wherein the intermediate layers are one of rigid layers, compliant layers and rigid and compliant layers.

45. The cleaning device of claim 40, wherein the cleaning material further comprises a release layer on top of a top surface of the cleaning pad layer that protects the cleaning pad layer.

45. The cleaning device of claim 40, wherein the cleaning material has a specific gravity, an elasticity, a tackiness, a thickness and a porosity.

46. The cleaning device of claim 45, wherein the cleaning material is one of a rubber, a natural polymer and a synthetic polymer.

47. The cleaning device of claim 46, wherein the cleaning material has the specific gravity in a range of 0.75 to 2.27, the modulus of elasticity in a range of 40-MPa to 600-MPa, the tackiness in a range of 20 to 800 grams, the thickness in a range between 25-um and 500-um, each layer has a hardness between 30 Shore A and 90 Shore A, and the porosity in a range of 10 to 150 micropores per inch.

48. The cleaning device of claim 44, wherein the cleaning pad layer further comprises a plurality of abrasive particles having a Mohs Hardness of 7 or greater.

49. The cleaning device of claim 48, wherein the cleaning material has the specific gravity in a range of 0.75 to 2.27, the modulus of elasticity in a range of 40-MPa to 600-MPa, the tackiness in a range of 20 to 800 grams, the thickness in a range between 25-um and 500-um, each layer has a hardness between 30 Shore A and 90 Shore A, and the porosity in a range of 10 to 150 micropores per inch.

50. The apparatus of claim 40, wherein the top surface of the cleaning material is a textured surface that cleans an inside surface and an outside surface of the contact element.

51. The apparatus of claim 40, wherein the cleaning layer has a set of microfeatures having a spacing, a moment of inertia and a total length of each microfeature determined based on at least a diameter of the content element.

52. The apparatus of claim 40, wherein the cleaning layer has a set of microfeatures and an array of streets, avenues or diagonals that decouple each microfeature from each other microfeature and a width of each street, avenue or diagonal is based on a dimension of the content element.

5 53. A method for picking and placing semiconductor elements, the method comprising:

performing a pick and place operation on a semiconductor device using a contact element of a pick and place apparatus, the contact element having an inner surface and a outer surface;

10 cleaning the contact element of the pick and place apparatus while the contact element is attached to the pick and place apparatus, wherein cleaning the contact element further comprises inserting an end of the contact element into a cleaning material and cleaning the inner and outer surface of the contact element by the cleaning material; and

performing the pick and place operation once the contact element is cleaned.

15 54. The method of claim 53, wherein cleaning the contact element further comprises transferring a piece of debris from a surface of the contact element to the cleaning material.

55. The method of claim 54, wherein transferring a piece of debris from a surface of the contact element further comprises attracting the piece of debris using a surface tackiness of a top surface of the cleaning material.

20 56. The method of claim 55, wherein transferring a piece of debris from a surface of the contact element further comprises transferring a piece of debris from an inner surface of the contact element to the surface of the cleaning material.

57. The method of claim 53, wherein performing the pick and place operation further comprises one of performing the pick and place operation for a packaged device being tested and performing the pick and place operation for a component used in a surface mount process.

25 58. The method of claim 53, wherein performing the pick and place operation further comprises one of performing the pick and place operation for a die attach machine and performing the pick and place operation for a flip-chip bonder machine.

59. The method of claim 53, wherein cleaning the contact element further comprises positioning the cleaning material adjacent to the pick and place apparatus.

60. The method of claim 53, wherein cleaning the contact element further comprises cleaning one of a vacuum aperture, a nozzle, a suction cup, a suction inlet, a vacuum collet of the pick and place apparatus.