CLAIMS

WHAT IS CLAIMED:

1. A method, comprising:

positioning a test probe adjacent to a side of a pillar bump formed above a metallization system of a semiconductor chip; and

performing a lateral force test on said pillar bump by contacting said side of said pillar bump with said test probe while moving said test probe at a substantially constant speed that is less than approximately 1 μm/sec.

2. The method of claim 1, wherein moving said test probe comprises moving said test probe along a path that is oriented substantially parallel to a plane of said metallization system during said lateral force test.

3. The method of claim 1, wherein moving said test probe comprises moving said test probe along a path that is oriented at a substantially non-zero angle relative to a plane of said metallization system during said lateral force test.

4. The method of claim 3, wherein said substantially non-zero angle is established so that said test probe is moving substantially toward said metallization system and so that a force imposed on said pillar bump by said test probe during said lateral force test comprises a component that is directed toward and induces a compressive load on said metallization system.

5. The method of claim 3, further comprising orienting said plane of said metallization system at a substantially non-zero angle relative to a horizontal plane during said lateral force test.

6. The method of claim 1, further comprising moving said test probe at a substantially constant speed that is less than approximately 0.1 μm/sec.

7. The method of claim 1, further comprising determining a behavioral interaction between said pillar bump and said metallization system during said lateral force test.

8. The method of claim 7, wherein determining said behavioral interaction between said pillar bump and said metallization system comprises:

measuring a force imposed on said pillar bump by said test probe and a distance traveled by said test probe during a duration of said lateral force test; and

generating a force/distance response curve from said measured force and distance traveled.

9. The method of claim 7, further comprising generating a comparative behavioral interaction curve and comparing said behavioral interaction between said pillar bump and said metallization system to said comparative behavioral interaction curve.

10. The method of claim 9, wherein comparing said behavioral interaction between said pillar bump and said metallization system to said comparative behavioral interaction curve comprises determining a material hardness characteristic of a material comprising said pillar bump.

11. The method of claim 9, wherein generating said comparative behavioral interaction curve comprises:

performing a first lateral force test on each of a plurality of first pillar bumps formed above a first metallization system of a first semiconductor chip, wherein performing each of said first lateral force tests comprises contacting a side of a respective one of said plurality of first pillar bumps with a first test probe while moving said first test probe at a first substantially constant speed that is less than approximately 1 μm/sec;

measuring a force imposed on each one of said plurality of first pillar bumps by said first test probe and a distance traveled by said first test probe during a duration of each respective first lateral force test; and

generating said comparative behavioral interaction curve using said measured force and distance data from each of said first lateral force tests.

12. The method of claim 11, wherein moving said first test probe comprises moving said first test probe along a path that is substantially parallel to a plane of said first metallization system during each respective first lateral force test.

13. The method of claim 1, wherein said metallization system comprises a plurality of metallization layers, and wherein at least one of said metallization layers comprises one of a low-k dielectric material and an ultra-low-k dielectric material.

14. The method of claim 1, wherein said pillar bump comprises copper.

15. A method, comprising:

performing a first lateral force test on a first pillar bump formed above a first metallization system of a first semiconductor chip, wherein performing said first lateral force test comprises contacting a side of said first pillar bump with a first test probe while moving said first test probe at a substantially constant speed along a path that is oriented at a substantially non-zero angle relative to a plane of said first metallization system, said substantially constant speed being less than approximately 0.1 μm/sec;

determining a first behavioral interaction between said first pillar bump and said first metallization system during said first lateral force test;

generating a comparative behavioral interaction curve representing a behavioral interaction between a second metallization system of a second semiconductor chip and a plurality of second pillar bumps formed thereabove; and

comparing said first behavioral interaction to said comparative behavioral interaction curve.

16. The method of claim 15, wherein determining said first behavioral interaction between said first pillar bump and said first metallization system comprises measuring a force imposed on said first pillar bump by said first test probe and a distance traveled by said first test probe during a duration of said first lateral force test, and generating a first force/distance response curve from said measured force and distance traveled.

17. The method of claim 15, wherein said comparative behavioral interaction curve comprises a first curve portion that occurs immediately after a second test probe contacts one of said plurality of second pillar bumps and a second curve portion that occurs immediately following said first curve portion, said first curve portion illustrating a substantially non-linear force/distance relationship and said second curve portion illustrating a substantially linear force/distance relationship.

18. The method of claim 15, further comprising forming a notch in said first pillar bump with said first test probe during said first lateral force test.

19. The method of claim 18, wherein forming said notch comprises forming a substantially asymmetrically shaped notch.

20. The method of claim 15, further comprising performing a second lateral force test on at least one additional pillar bump formed above said first metallization

system, determining a second behavioral interaction between said at least one additional pillar bump and said first metallization system during a duration of said second lateral force test, and comparing said second behavioral interaction to said comparative behavioral interaction curve.

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CLAIMS

1. A method, comprising:

positioning a test probe adjacent to a side of a pillar bump formed above a metallization system of a semiconductor chip; and

performing a lateral force test on said pillar bump by contacting said side of said pillar bump with said test probe and, while said test probe is in contact with said side of said pillar bump, moving said test probe relative to said metallization system at a substantially constant speed that is less than approximately 1 μm/sec.

2. The method of claim 1, wherein moving said test probe comprises moving said test probe along a path that is oriented substantially parallel to a plane of said metallization system during said lateral force test.

3. The method of claim 1, wherein moving said test probe comprises moving said test probe along a path that is oriented at a substantially non-zero angle relative to a plane of said metallization system during said lateral force test.

4. The method of claim 3, further comprising orienting said plane of said metallization system at a substantially non-zero angle relative to a horizontal plane during said lateral force test.

5. The method of claim 1, further comprising moving said test probe at a substantially constant speed that is less than approximately 0.1 μm/sec.

6. The method of claim 1, further comprising determining a behavioral interaction between said pillar bump and said metallization system during said lateral force test.

7. The method of claim 6, wherein determining said behavioral interaction between said pillar bump and said metallization system comprises:

measuring a force imposed on said pillar bump by said moving test probe and a distance traveled by said test probe during a duration of said lateral force test; and

generating a force/distance response curve from said measured force and distance traveled.

8. The method of claim 6, further comprising generating a comparative behavioral interaction curve and comparing said behavioral interaction between said pillar bump and said metallization system to said comparative behavioral interaction curve.

9. The method of claim 8, wherein comparing said behavioral interaction between said pillar bump and said metallization system to said comparative behavioral interaction curve comprises determining a material hardness characteristic of a material comprising said pillar bump.

10. The method of claim 8, wherein generating said comparative behavioral interaction curve comprises:

performing a first lateral force test on each of a plurality of first pillar bumps formed above a first metallization system of a first semiconductor chip, wherein performing each of said first lateral force tests comprises contacting a side of a respective one of said plurality of first pillar bumps with a first test probe while moving said first test probe at a first substantially constant speed that is less than approximately 1 μm/sec;

measuring a force imposed on each one of said plurality of first pillar bumps by said first test probe and a distance traveled by said first test probe during a duration of each respective first lateral force test; and

generating said comparative behavioral interaction curve using said measured force and distance data from each of said first lateral force tests.

11. The method of claim 10, wherein moving said first test probe comprises moving said first test probe along a path that is substantially parallel to a plane of said first metallization system during each respective first lateral force test.

12. The method of claim 1, wherein said metallization system comprises a plurality of metallization layers, and wherein at least one of said metallization layers comprises one of a low-k dielectric material and an ultra-low-k dielectric material.

13. The method of claim 1, wherein said pillar bump comprises copper.

14. A method, comprising:

performing a first lateral force test on a first pillar bump formed above a first metallization system of a first semiconductor chip, wherein performing said first lateral force test comprises contacting a side of said first pillar bump with a first test probe while moving said first test probe at a substantially constant speed along a path that is oriented at a substantially non-zero angle relative to a plane of said first metallization system, said substantially constant speed being less than approximately 0.1 μm/sec;

determining a first behavioral interaction between said first pillar bump and said first metallization system during said first lateral force test;

generating a comparative behavioral interaction curve representing a behavioral interaction between a second metallization system of a second semiconductor chip and a plurality of second pillar bumps formed thereabove; and

comparing said first behavioral interaction to said comparative behavioral interaction curve.

15. The method of claim 14, wherein determining said first behavioral interaction between said first pillar bump and said first metallization system comprises measuring a force imposed on said first pillar bump by said first test probe and a distance traveled by said first test probe during a duration of said first lateral force test, and generating a first force/distance response curve from said measured force and distance traveled.

16. The method of claim 14, wherein said comparative behavioral interaction curve comprises a first curve portion that occurs immediately after a second test probe contacts one of said plurality of second pillar bumps and a second curve portion that occurs immediately following said first curve portion, said first curve portion illustrating a substantially non-linear force/distance relationship and said second curve portion illustrating a substantially linear force/distance relationship.

17. The method of claim 14, further comprising forming a notch in said first pillar bump with said first test probe during said first lateral force test.

18. The method of claim 17, wherein forming said notch comprises forming a substantially asymmetrically shaped notch.

19. The method of claim 14, further comprising performing a second lateral force test on at least one additional pillar bump formed above said first metallization system, determining a second behavioral interaction between said at least one additional pillar bump and said first metallization system during a duration of said second lateral force test, and comparing said second behavioral interaction to said comparative behavioral interaction curve.

20. A method, comprising:

positioning a test probe adjacent to a side of a pillar bump formed above a metallization system of a semiconductor chip; and

performing a lateral force test on said pillar bump by contacting said side of said pillar bump with said test probe and, while said test probe is in contact with said side of said pillar bump, moving said test probe relative to said metallization system at a substantially constant speed that is less than approximately 1 μm/sec along a path that is oriented at a substantially non-zero angle relative to a plane of said metallization system, wherein said substantially non-zero angle is established so that said test probe is moving substantially toward said metallization system and so that a force imposed on said pillar bump by said moving test probe during said lateral force test comprises a component that is directed toward and induces a compressive load on said metallization system.

21. A system employed for testing and evaluating the metallization layers of a back-end-of-line (BEOL) metallization system and pillar bumps formed thereon in accordance with method of any one of the preceding claims.

22. A test configuration for testing the behavioral interaction between a representative pillar bump and an underlying metallization system of semiconductor chip in accordance with any one of the claims 1-20.