CLAIMS

1. A seal (40, 140) for sealing an interface (16) between a container (12) and a lid (14) of a process chamber(10), the seal (40, 140) comprising:

a first seal element (44, 144) having a deflectable portion (52, 152) and a protrusion (56, 156) extending radially inwardly from the deflectable portion (52, 152); and

a second seal element (48, 148) having at least one sealing surface and a radially outwardly extending recess (60, 160) in which the protrusion (56, 156) of the first seal element (44, 144) is received, a radially inner surface of the protrusion (56, 156) abutting a radially inner surface of the recess (60, 160);

wherein the protrusion (56, 156) and recess (60, 160) interlock to restrict separation of the first and second seal elements (44, 48, 144, 148); and

wherein the protrusion (56, 156) has an inclined surface that is radially coextensive with a major portion of the sealing surface and extends to a maximum axial extent of the protrusion (56, 156).

2. A seal (40, 140) as set forth in claim 1, wherein the second seal element (48, 148) has an abutment surface abutting the inclined surface of the protrusion (56, 156), whereby during compression of the seal (40, 140) when a force is applied to the second sealing element (48, 148) tending to separate it from the first seal element (44, 144), a reaction force is generated at the inclined surface that tends to apply an axial sealing force to the at least one sealing surface of the second sealing element (48, 148).

3. A seal (40, 140) as set forth in either one of claims 1 or 2, wherein the inclined surface extends to the radially outer extent of the protrusion (56, 156).

4. A seal (40, 140) as set forth in any one of claims 1-3, wherein the sealing surface and the abutment surface of the second seal element (48, 148)

slope away from each other in the radially outward direction thereby forming a wedging portion of the second seal element (48, 148) for applying an axial sealing force to the sealing surface upon compression of the first seal element (44, 144).

5. A seal (40, 140) as set forth in any one of claims 1-4, wherein the at least one sealing surface is configured to pivot about a point located radially inwardly and outside of the second seal element (48, 148) when the seal (40, 140) is deflected.

6. A seal (40, 140) as set forth in any one of claims 1-5, wherein the inclined surface of the protrusion (56, 156) extends to a midpoint of the sealing surface.

7. A seal (40, 140) as set forth in any one of claims 1-6, wherein the recess (60, 160) and/or protrusion (56) have an anti-rotatable fit to restrict rotation of the first seal element (44, 144) relative to the second seal element (48, 148).

8. A seal (40, 140) as set forth in any one of claims 1-7, wherein the second seal element (48, 148) further comprises upper and lower arms (64, 68, 164, 168) extending radially from a central axially extending body (72, 172), the arms (64, 68, 164, 168) and body (72, 172) defining therebetween the recess (60, 160) and being adapted to engage opposing sides of the protrusion (56, 156).

9. A seal (40, 140) as set forth in any one of claims 1-8, wherein the recess (60, 160) has a dovetail-shape cross-section.

10. A seal (40, 140) as set forth in any one of claims 1-9, wherein the second seal element (48, 148) is supported by the first seal element (44, 144), and wherein the first seal element (44, 144) and second seal element (48, 148) are adapted to seal in series.

11. A seal (40, 140) as set forth in any one of claims 1-10, wherein the first seal element (44, 144) extends above and below the height of the second seal element (48, 148) an approximately equal distance when in an undeflected state.

12. A seal (40, 140) as set forth in any one of claims 1-11, wherein the first and second seal elements (44, 48, 144, 148) are generally symmetrical about a common central radial axis.

13. A seal (140) as set forth in any one of claims 1-12, wherein the second seal element (148) has radially outwardly opening compression grooves (192, 194) spaced axially above and below the recess (160), the grooves (192, 194) defining upper and lower lip portions (196, 198) of the second sealing element (148) adapted to seal against respective surfaces.

14. A seal (40, 140) as set forth in any one of claims 1-13, wherein the first seal element (44, 144) is composed of an elastomeric material.

15. A seal (40, 140) as set forth in any one of claims 1-14, wherein the second seal element (48, 148) is composed of a polymeric material.

16. A seal (40, 140) as set forth in claim 15, wherein the polymeric material includes at least one of PEEK and PTFE.

17. A seal (40, 140) as set forth in any one of claims 1-16, wherein the first seal element (44, 144) and second seal element (48, 148) are bonded together.

18. A process chamber (10) comprising a container (12) defining a processing space (20) and an access opening (22) into the processing space (20), a lid (14) convertible between a sealed condition whereat the lid (14) seals the

access opening (22) into the processing space (20), and a loading/unloading condition whereat the access opening (22) is uncovered for insertion/withdrawal of a substrate (24), and a seal (40, 140) as set forth in any one of claims 1-17 for sealing an interface (16) between the container (12) and the lid (14).

19. A seal (40, 140) for sealing an interface (16) between a container (12) and a lid (14) of a process chamber (10), the seal (40, 140) comprising:

a first seal element (44, 144) having a deflectable portion (52, 152) and a protrusion (56, 156) extending radially from the deflectable portion (52, 152); and

a second seal element (48, 148) having at least one sealing surface and a radially extending recess (60, 160) in which the protrusion (56, 156) of the first seal element (44, 144) is received;

wherein the protrusion (56, 156) and recess (60, 160) interlock to restrict separation of the first and second seal elements (44, 48, 144, 148); and

wherein the protrusion (56, 156) has an inclined surface that is radially coextensive with a major portion of the sealing surface and extends to a maximum axial extent of the protrusion (56, 156), such maximum axial extent being generally radially aligned with a midpoint of the sealing surface.

20. A seal (40, 140) for sealing an interface (16) between a container (12) and a lid (14) of a process chamber (10), the seal (40, 140) comprising:

a first seal element (44, 144) having a deflectable portion (52, 152) and a protrusion (56, 156) extending radially from the deflectable portion (52, 152); and

a second seal element (48, 148) having at least one sealing surface and a radially extending recess (60, 160) in which the protrusion (56, 156) of the first seal element (44, 144) is received;

wherein the protrusion (56, 156) and recess (60, 160) interlock to restrict separation of the first and second seal elements (44, 48, 144, 148);

wherein the protrusion (56, 156) has an inclined surface that is radially coextensive with a major portion of the sealing surface and extends to a maximum axial extent of the protrusion (56, 156); and

wherein the first and second seal elements (44, 48, 144, 148) are generally symmetrical about a common central radial axis.

CLAIMS

1. A seal for sealing an interface between a container and a lid of a process chamber, the seal comprising:

a first seal element having a deflectable portion and a protrusion extending radially inwardly from the deflectable portion; and

a second seal element having at least one sealing surface and a radially outwardly extending recess in which the protrusion of the first seal element is received, a radially inner surface of the protrusion abutting a radially inner surface of the recess;

wherein the protrusion and recess interlock to restrict separation of the first and second seal elements;

wherein the protrusion has an inclined surface that is radially coextensive with a major portion of the sealing surface and extends to a maximum axial extent of the protrusion; and

wherein the at least one sealing surface is configured to pivot about a point located radially inwardly and outside of the second seal member when the seal is deflected.

2. A seal as set forth in claim 1, wherein the second seal element has an abutment surface abutting the inclined surface of the protrusion, whereby during compression of the seal when a force is applied to the second sealing element tending to separate it from the first seal element, a reaction force is generated at the inclined surface that tends to apply an axial sealing force to the at least one sealing surface of the second sealing element.

3. A seal as set forth in claim 1, wherein the inclined surface extends to the radially outer extent of the protrusion.

4. A seal as set forth in claim 1, wherein the sealing surface and the abutment surface of the second seal element slope away from each other in the radially outward direction thereby forming a wedging portion of the second seal element for applying an axial sealing force to the sealing surface upon compression of the first seal element.

5. A seal as set forth in claim 1, wherein the inclined surface of the protrusion extends to a midpoint of the sealing surface.

6. A seal as set forth in claim 1, wherein the recess and/or protrusion have an anti-rotatable fit to restrict rotation of the first seal member relative to the second seal member.

7. A seal as set forth in claim 1, wherein the second seal member further comprises upper and lower arms extending radially from a central axially extending body, the arms and body defining therebetween the recess and being adapted to engage opposing sides of the protrusion.

8. A seal as set forth in claim 1, wherein the recess has a dovetail-shape cross-section.

9. A seal as set forth in claim 1, wherein the second seal element is supported by the first seal element, and wherein the first seal element and second seal element are adapted to seal in series.

10. A seal as set forth in claim 1, wherein the first seal element extends above and below the height of the second seal element an approximately equal distance when in an undeflected state.

11. A seal as set forth in claim 1, wherein the first and second seal elements are generally symmetrical about a common central radial axis.

12. A seal as set forth in claim 1, wherein the second seal element has radially outwardly opening compression grooves spaced axially above and below the recess, the grooves defining upper and lower lip portions of the second sealing element adapted to seal against respective surfaces.

13. A seal as set forth in claim 1, wherein the first seal element is composed of an elastomeric material.

14. A seal as set forth in claim 1, wherein the second seal element is composed of a polymeric material.

15. A seal as set forth in claim 14, wherein the polymeric material includes at least one of PEEK and PTFE.

16. A seal as set forth in claim 1, wherein the first seal element and second seal element are bonded together.

17. A process chamber comprising a container defining a processing space and an access opening into the processing space, a lid convertible between a sealed condition whereat it seals the access opening into the processing space, and a loading/unloading condition whereat the access opening is uncovered for insertion/withdrawal of a substrate, and a seal as set forth in claim 1 for sealing an interface between the container and the lid.

18. A seal for sealing an interface between a container and a lid of a process chamber, the seal comprising:

a first seal element having a deflectable portion and a protrusion extending radially from the deflectable portion; and

a second seal element having at least one sealing surface and a radially extending recess in which the protrusion of the first seal element is received;

wherein the protrusion and recess interlock to restrict separation of the first and second seal elements; and

wherein the protrusion has an inclined surface that is radially coextensive with a major portion of the sealing surface and extends to a maximum axial extent of the protrusion, such maximum axial extent being generally radially aligned with a midpoint of the sealing surface.

19. A seal for sealing an interface between a container and a lid of a process chamber, the seal comprising:

a first seal element having a deflectable portion and a protrusion extending radially from the deflectable portion; and

a second seal element having at least two sealing surfaces and a radially extending recess in which the protrusion of the first seal element is received;

wherein the protrusion and recess interlock to restrict separation of the first and second seal elements;

wherein the protrusion has an inclined surface that is radially coextensive with a major portion of the sealing surface and extends to a maximum axial extent of the protrusion; and

wherein the second seal member further comprises upper and lower arms each having a respective locking portion abutting the protrusion and a respective sealing end having one of the at least two sealing surfaces, the sealing ends spaced from the first seal element.

20. A seal as set forth in claim 19, wherein the second seal element has an abutment surface abutting the inclined surface of the protrusion, whereby during compression of the seal when a force is applied to the second sealing element

tending to separate it from the first seal element, a reaction force is generated at the inclined surface that tends to apply an axial sealing force to the at least one sealing surface of the second sealing element.

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