CLAIMS

1. A wear part for earth engaging equipment comprising:

a substrate for attachment to the earth engaging equipment, the substrate having a surface;

a thin, expendable sheet metal shell connected to the substrate to define a cavity between the surface of the substrate and the shell; and

a composite material filling the cavity and forming a coating on at least a portion of the surface of the substrate, the composite material comprising a hard particulate material infiltrated with a metallic brazing material.

2. The wear part for earth engaging equipment of claim 1, wherein the shell has an opening to an exterior of the shell, and wherein the composite material is exposed to the exterior of the shell through the opening.

3. The wear part for earth engaging equipment of claim 2, further comprising a reservoir connected to the shell and positioned outside the cavity in communication with the opening.

4. The wear part for earth engaging equipment of any of claims 1-3, wherein the shell is connected to the surface of the substrate by welding or brazing.

5. The wear part for earth engaging equipment of any of claims 1-4, wherein the shell further comprises a conformal band in surface-to-surface contact with a portion of the covered surface of the substrate around an entire periphery of the shell, wherein the shell is connected to the substrate by welding or brazing at least at the conformal band.

6. The wear part for earth engaging equipment of any of claims 1-5, wherein the substrate has a bonding surface in surface-to-surface contact with the conformal band, and wherein at least a portion of the substrate within the cavity is inset with respect to

the bonding surface, such that the composite material has an outer surface that is flush with the bonding surface.

7. The wear part for earth engaging equipment of any of claims 1-6, wherein the brazing material is bonded to the surface of the substrate.

8. The wear part for earth engaging equipment of any of claims 1-7, wherein the brazing material is further bonded to the shell.

9. The wear part for earth engaging equipment of any of claims 1-8, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a back piece having a back flange extending transversely from a front edge of the back piece, wherein the front piece and the back piece are joined together to form the shell by welding or brazing the front flange to the back flange.

10. The wear part for earth engaging equipment of any of claims 1-9, wherein the particulate material comprises tungsten carbide, and the metallic brazing material comprises Ni—Cr—Si—B brazing alloy.

11. The wear part for earth engaging equipment of any of claims 1-10, wherein the substrate has a hole in the surface, further comprising an insert rod received in the hole, wherein the hole is covered by the composite material.

12. A hardfaced wearpart for abrasive applications comprising:

a tool to be attached to earth engaging equipment having a surface at a point of the tool and a bonding surface located proximate the surface;

a composite hardfacing material forming a coating on at least a portion of the surface, the composite hardfacing material comprising a hard particulate material

infiltrated with a metallic brazing material, wherein the metallic brazing material is bonded to the surface to connect the composite hardfacing material to the tool; and

a sheet metal shell in contact with the composite material and surrounding the composite material, the shell having a conformal band in contact with the bonding surface of the tool, wherein the shell is connected to the tool by welding or brazing at least between the conformal band and the bonding surface, wherein a cavity is defined between the surface of the substrate and the shell, and the composite hardfacing material fills the shell.

13. The wearpart for abrasive applications of claim 12, wherein the shell has an opening to an exterior of the shell, and wherein the composite hardfacing material is exposed to the exterior of the shell through the opening.

14. The wearpart for abrasive applications of claim 13, further comprising a reservoir connected to the shell and positioned outside the cavity in communication with the opening.

15. The wearpart for abrasive applications of any of claims 12-14, wherein the conformal band contacts the bonding surface of the tool around an entire periphery of the shell and is welded or brazed to the conformal band around the entire periphery.

16. The wearpart for abrasive applications of any of claims 12-15, wherein the brazing material is bonded to the shell.

17. The wearpart for abrasive applications of any of claims 12-16, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a back piece having a back flange extending transversely from a front edge of the back piece, wherein the front piece and the back piece are joined together to form the shell by welding or brazing the front flange to the back flange.

18. The wearpart for abrasive applications of any of claims 12-17, wherein the particulate material comprises tungsten carbide, and the metallic brazing material comprises Ni—Cr—Si—B brazing alloy.

19. The wearpart for abrasive applications of any of claims 12-18, wherein the substrate has a hole in the surface, further comprising an insert rod received in the hole, wherein the hole is covered by the composite hardfacing material.

20. A method for making a wearpart for abrasive applications comprising: providing a metal substrate having a surface; connecting an expendable, thin sheet metal shell to the surface of the substrate to define a cavity between the shell and the surface; placing a hard particulate material within the cavity, in close proximity to the surface; placing a metallic brazing material in communication with the cavity; heating the brazing material to a temperature above a melting point of the brazing material and holding the temperature for a time sufficient for the brazing material to infiltrate the particulate material in molten form and contact the surface of the substrate; and cooling the brazing material to solidify the brazing material and form a wear resistant composite coating on the surface of the substrate.

21. The method for making a wearpart of claim 20, wherein the shell has an opening to an exterior of the shell and a reservoir is connected to the shell and positioned outside the cavity in communication with the opening, and wherein the brazing material is placed within the reservoir to be in communication with the cavity.

22. The method for making a wearpart of claim 21, wherein the reservoir is integrally formed with the shell.

23. The method for making a wearpart of any one of claims 20-22, wherein connecting the shell to the substrate comprises welding or brazing the shell to the surface of the substrate.

24. The method for making a wearpart of any one of claims 20-23, wherein the shell further comprises a conformal band extending around a periphery of the shell, and wherein connecting the shell to the substrate comprises welding or brazing the conformal band to the surface of the substrate, such that the conformal band is in surface-to-surface contact with a portion of the surface of the substrate around the entire conformal band.

25. The method for making a wearpart of any one of claims 20-24, wherein the brazing material is bonded to the shell after the brazing material is solidified.

26. The method for making a wearpart of any one of claims 20-25, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a back piece having a back flange extending transversely from a front edge of the back piece, wherein the method further comprises joining the front piece and the back piece together to form the shell by welding or brazing the front flange to the back flange.

27. The method for making a wearpart of any one of claims 20-26, wherein the particulate material comprises tungsten carbide, and the metallic brazing material comprises Ni—Cr—Si—B brazing alloy, and wherein the brazing material is heated to a temperature of approximately 2050° F. for a time of approximately 30 to 60 minutes.

28. The method for making a wearpart of any one of claims 20-27, further comprising welding or brazing pieces of sheet metal together to form the shell.

29. An assembly to engage the ground during operation of ground engaging machinery comprising:

a tool to be attached to the ground engaging machinery having a surface; and

a sheet metal shell connected to the tool and having a conformal band conforming to at least a portion of the surface to define a cavity between the surface and the shell, the shell further having an opening to an exterior of the shell, wherein the shell is connected to the tool by welding or brazing the conformal band to the at least a portion of the surface.

30. The assembly of claim 29, wherein the assembly is configured for forming a wear resistant composite coating on the surface by filling the cavity through the opening with a hard particulate material, placing a metallic brazing material in communication with the cavity, heating the assembly to a temperature above a melting point of the brazing material and holding the temperature for a time sufficient for the brazing material to infiltrate the particulate material in molten form and contact the surface of the tool, and cooling the assembly to solidify the matrix material and form the wear resistant composite coating on the surface.

31. The assembly of any of claims 29-30, further comprising a composite material filling the cavity and forming a coating on at least a portion of the surface of the tool, the composite material comprising a hard particulate material infiltrated with a metallic brazing material, wherein the brazing material is bonded to the surface.

32. The assembly of any of claims 29-31, further comprising a reservoir connected to the shell and positioned outside the cavity in communication with the opening.

33. The assembly of claim 32 wherein the reservoir is configured to have the brazing material placed therein to be in communication with the cavity.

34. The assembly of claim 33, wherein the reservoir has a flared shape and is integrally formed with the shell.

35. The assembly of any of claims 29-34, wherein the conformal band extends

around an entire periphery of the shell and around an entire periphery of the surface.

36. The assembly of any of claims 29-35, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a back piece having a back flange extending transversely from a front edge of the back piece, wherein the front piece and the back piece are joined together to form the shell by welding or brazing the front flange to the back flange.

37. The assembly of any of claims 29-36, wherein the tool has a hole in the surface, further comprising an insert rod received in the hole.

38. The assembly of claim 37, wherein spaces are defined between the insert rod and an interior wall of the hole.

39. An assembly to engage the ground during operation of earth engaging equipment comprising: a tool to be attached to the earth engaging equipment having a surface; a sheet metal shell covering at least a portion of the surface and defining a cavity between the shell and the surface, the shell further having an opening to an exterior of the shell; and a plurality of spacers engaging the tool and the shell and separating the tool from the shell.

40. The assembly of claim 39, wherein the assembly is configured for forming a wear resistant composite coating on the surface by filling the cavity with a hard particulate material, placing a metallic brazing material in communication with the cavity, heating the assembly to a temperature above a melting point of the brazing material and holding the temperature for a time sufficient for the brazing material to infiltrate the particulate material in molten form and contact the surface of the tool, and cooling the assembly to solidify the matrix material and form the wear resistant composite coating on the surface.

41. The assembly of claim 40, further comprising a wall extending from the shell and defining a reservoir connected to the shell and positioned outside the cavity in communication with the opening, wherein the reservoir is configured to have a brazing material placed therein to be in communication with the cavity.

42. The assembly of any of claims 39-41, further comprising a composite material filling the cavity and forming a coating on at least a portion of the surface of the tool, the composite material comprising a hard particulate material infiltrated with a metallic brazing material, wherein the brazing material is bonded to the surface.

43. A wear part for earth engaging equipment comprising:

a substrate adapted to secure to earth engaging equipment, the substrate having an outer operating surface to engage the ground during operation of the earth engaging equipment, the outer operating surface including a covered surface;

a thin, expendable sheet metal shell connected to the substrate to define a cavity between the covered surface of the substrate and the shell; and

a composite material filling the cavity and forming a coating on at least a portion of the covered surface of the substrate, the composite material comprising a hard particulate material infiltrated with a metallic brazing material.

44. The wear part of claim 43, wherein the shell has an opening to an exterior of the shell, and wherein the composite material is exposed to the exterior of the shell through the opening.

45. The wear part of claim 44, further comprising a flared reservoir connected to the shell and positioned outside the cavity in communication with the opening.

46. The wear part of any of claims 43-45, wherein the shell is connected to the surface of the substrate by welding or brazing.

47. The wear part of claim 46, wherein the shell further comprises a conformal band in surface-to-surface contact with a portion of the surface of the substrate around an entire periphery of the shell, wherein the shell is connected to the substrate by welding or brazing at least at the conformal band.

48. The wear part of claim 47, wherein the substrate has a bonding surface in surface-to-surface contact with the conformal band, and wherein at least a portion of the substrate within the cavity is inset with respect to the bonding surface.

49. The wear part of any of claims 43-48, wherein the brazing material is further bonded to the shell.

50. The wear part of any of claims 43-49, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a back piece having a back flange extending transversely from a front edge of the back piece, wherein the front piece and the back piece are joined together to form the shell by welding or brazing the front flange to the back flange.

51. The wear part of any of claims 43-50, wherein the hard material has a porous structure that is infiltrated by the metallic brazing material to form the composite hardfacing material.

52. A method for making a wearpart for earth engaging equipment comprising: connecting a metal shell to a surface of a substrate to define a cavity between the shell and the surface; placing a hard material within the cavity; placing a metallic brazing material in communication with the cavity; heating the brazing material to a temperature above a melting point of the brazing material and holding the temperature for a time sufficient for the brazing material to contact the hard material and the surface of the substrate in molten form; and cooling the brazing material to solidify the brazing material and bond the hard material to the surface of the substrate.

53. The method of claim 52, wherein the shell has an opening to an exterior of the shell and a reservoir is connected to the shell and positioned outside the cavity in communication with the opening, and wherein the brazing material is placed within the reservoir to be in communication with the cavity.

54. The method of any of claims 52-53, wherein connecting the shell to the substrate comprises welding or brazing the shell to the surface of the substrate.

55. The method of claim 54, wherein the shell further comprises a conformal band extending around a periphery of the shell, and wherein connecting the shell to the substrate comprises welding or brazing the conformal band to the surface of the substrate, such that the conformal band is in surface-to-surface contact with a portion of the surface of the substrate around the entire conformal band.

56. The method of any of claims 52-55, wherein the brazing material is bonded to the shell after the brazing material is solidified.

57. The method of any of claims 52-56, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a back piece having a back flange extending transversely from a front edge of the back piece, wherein the method further comprises joining the front piece and the back piece together to form the shell by welding or brazing the front flange to the back flange.

58. The method of any of claims 52-57, wherein the particulate material comprises tungsten carbide, and the metallic brazing material comprises Ni—Cr—Si—B brazing alloy, and wherein the brazing material is heated to a temperature of approximately 2050° F. for a time of approximately 30 to 60 minutes.

59. The method of any of claims 52-58, further comprising welding or brazing pieces

of sheet metal together to form the shell.

60. The method of any of claims 52-59, wherein the hard material and the metallic brazing material form a composite hardfacing material covering the surface of the substrate.

61. The method of claims 60, wherein the hard material has a porous structure that is infiltrated by the metallic brazing material in molten form to form the composite hardfacing material.

62. The method of any of claims 60-61, wherein the hard material comprises a particulate material that is infiltrated by the metallic brazing material in molten form to form the composite hardfacing material.

63. The method of any of claims 52-62, wherein the shell is formed of sheet metal.

64. An assembly for abrasive applications comprising: a substrate to be attached to earth engaging equipment having a surface; and a metal shell connected to the substrate to define a cavity between the surface and the shell, the shell further having an opening to an exterior of the shell.

65. The assembly for abrasive applications of claims 64, wherein the shell is formed of sheet metal.

66. The assembly for abrasive applications of any of claims 64-65, wherein the shell is connected to the substrate by welding or brazing the shell to the surface.

67. The assembly for abrasive applications of any of claims 64-66, wherein the shell has a conformal band conforming to at least a portion of the surface.

68. The assembly for abrasive applications of claims 67, wherein the shell is connected to the substrate by welding or brazing the conformal band to the at least a portion of the surface.

69. The assembly for abrasive applications of any of claims 64-68, wherein the assembly is configured for forming a wear resistant composite coating on the surface by filling the cavity through the opening with a hard particulate material, placing a metallic brazing material in communication with the cavity, heating the assembly to a temperature above a melting point of the brazing material and holding the temperature for a time sufficient for the brazing material to infiltrate the particulate material in molten form and contact the surface of the tool, and cooling the assembly to solidify the matrix material and form the wear resistant composite coating on the surface.

CLAIMS

What is claimed is:

1. An article comprising:

a substrate having a surface;

a sheet metal shell connected to the substrate to define a cavity between the surface of the substrate and the shell; and

a composite material filling the cavity and forming a coating on at least a portion of the surface of the substrate, the composite material comprising a hard particulate material infiltrated with a metallic brazing material.

2. The article of claim 1, wherein the shell has an opening to an exterior of the shell, and wherein the composite material is exposed to the exterior of the shell through the opening.

3. The article of claim 2, further comprising a reservoir connected to the shell and positioned outside the cavity in communication with the opening.

4. The article of claim 1, wherein the shell is connected to the surface of the substrate by welding or brazing.

5. The article of claim 4, wherein the shell further comprises a conformal band in surface-to-surface contact with a portion of the surface of the substrate around an entire periphery of the shell, wherein the shell is connected to the substrate by welding or brazing at least at the conformal band.

6. The article of claim 6, wherein the substrate has a bonding surface in surface-to-surface contact with the conformal band, and wherein at least a portion of the substrate within the cavity is inset with respect to the bonding surface, such that the composite material has an outer surface that is flush with the bonding surface.

7. The article of claim 1, wherein the brazing material is bonded to the surface of the substrate.

8. The article of claim 7, wherein the brazing material is further bonded to the shell.

9. The article of claim 1, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a

back piece having a back flange extending transversely from a front edge of the back piece, wherein the front piece and the back piece are joined together to form the shell by welding or brazing the front flange to the back flange.

10. The article of claim 1, wherein the particulate material comprises tungsten carbide, and the metallic brazing material comprises Ni-Cr-Si-B brazing alloy.

11. The article of claim 1, wherein the substrate has a hole in the surface, further comprising an insert rod received in the hole, wherein the hole is covered by the composite material.

12. A hardfaced wearpart comprising:

a tool having a surface at a point of the tool and a bonding surface located proximate the surface;

a composite hardfacing material forming a coating on at least a portion of the surface, the composite hardfacing material comprising a hard particulate material infiltrated with a metallic brazing material, wherein the metallic brazing material is bonded to the surface to connect the composite hardfacing material to the tool; and

a sheet metal shell in contact with the composite material and surrounding the composite material, the shell having a conformal band in contact with the bonding surface of the tool, wherein the shell is connected to the tool by welding or brazing at least between the conformal band and the bonding surface,

wherein a cavity is defined between the surface of the substrate and the shell, and the composite hardfacing material fills the shell.

13. The wearpart of claim 12, wherein the shell has an opening to an exterior of the shell, and wherein the composite hardfacing material is exposed to the exterior of the shell through the opening.

14. The wearpart of claim 13, further comprising a reservoir connected to the shell and positioned outside the cavity in communication with the opening.

15. The wearpart of claim 12, wherein the conformal band contacts the bonding surface of the tool around an entire periphery of the shell and is welded or brazed to the conformal band around the entire periphery.

16. The wearpart of claim 12, wherein the brazing material is bonded to the shell.

17. The wearpart of claim 12, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a back piece having a back flange extending transversely from a front edge of the back piece, wherein the front piece and the back piece are joined together to form the shell by welding or brazing the front flange to the back flange.

18. The wearpart of claim 12, wherein the particulate material comprises tungsten carbide, and the metallic brazing material comprises Ni-Cr-Si-B brazing alloy.

19. The wearpart of claim 12, wherein the substrate has a hole in the surface, further comprising an insert rod received in the hole, wherein the hole is covered by the composite hardfacing material.

20. A method comprising:

providing a substrate having a surface;

connecting a sheet metal shell to the surface of the substrate to define a cavity between the shell and the surface;

placing a hard particulate material within the cavity, in close proximity to the surface;

placing a metallic brazing material in communication with the cavity;

heating the brazing material to a temperature above a melting point of the brazing material and holding the temperature for a time sufficient for the brazing material to infiltrate the particulate material in molten form and contact the surface of the substrate; and

cooling the brazing material to solidify the brazing material and form a wear resistant composite coating on the surface of the substrate.

21. The method of claim 20, wherein the shell has an opening to an exterior of the shell and a reservoir is connected to the shell and positioned outside the cavity in communication with the opening, and wherein the brazing material is placed within the reservoir to be in communication with the cavity.

22. The method of claim 21, wherein the reservoir is integrally formed with the shell.

23. The method of claim 20, wherein connecting the shell to the substrate comprises welding or brazing the shell to the surface of the substrate.

24. The method of claim 23, wherein the shell further comprises a conformal band extending around a periphery of the shell, and wherein connecting the shell to the substrate comprises welding or brazing the conformal band to the surface of the substrate, such that the conformal band is in surface-to-surface contact with a portion of the surface of the substrate around the entire conformal band.

25. The method of claim 20, wherein the brazing material is bonded to the shell after the brazing material is solidified.

26. The method of claim 20, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a back piece having a back flange extending transversely from a front edge of the back piece, wherein the method further comprises joining the front piece and the back piece together to form the shell by welding or brazing the front flange to the back flange.

27. The method of claim 20, wherein the particulate material comprises tungsten carbide, and the metallic brazing material comprises Ni-Cr-Si-B brazing alloy, and wherein the brazing material is heated to a temperature of approximately 2050°F for a time of approximately 30 to 60 minutes.

28. The method of claim 20, further comprising welding or brazing pieces of sheet metal together to form the shell.

29. An assembly comprising:

a tool having a surface; and

a sheet metal shell connected to the tool and having a conformal band conforming to at least a portion of the surface to define a cavity between the surface and the shell, the shell further having an opening to an exterior of the shell,

wherein the shell is connected to the tool by welding or brazing the conformal band to the at least a portion of the surface.

30. The assembly of claim 29, wherein the assembly is configured for forming a wear resistant composite coating on the surface by filling the cavity through the opening with a hard particulate material, placing a metallic brazing material in communication with the cavity, heating the assembly to a temperature above a melting point of the brazing material and holding the temperature for a time sufficient for the brazing material to infiltrate the particulate material in molten form and contact the surface of the tool, and cooling the assembly to solidify the matrix material and form the wear resistant composite coating on the surface.

31. The assembly of claim 30, further comprising a flared reservoir connected to the shell and positioned outside the cavity in communication with the opening, wherein the reservoir is configured to have the brazing material placed therein to be in communication with the cavity.

32. The assembly of claim 29, further comprising a composite material filling the cavity and forming a coating on at least a portion of the surface of the tool, the composite material comprising a hard particulate material infiltrated with a metallic brazing material, wherein the brazing material is bonded to the surface.

33. The assembly of claim 29, further comprising a reservoir connected to the shell and positioned outside the cavity in communication with the opening.

34. The assembly of claim 33, wherein the reservoir has a flared shape and is integrally formed with the shell.

35. The assembly of claim 29, wherein the conformal band extends around an entire periphery of the shell and around an entire periphery of the surface.

36. The assembly of claim 29, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a back piece having a back flange extending transversely from a front edge of the back piece, wherein the front piece and the back piece are joined together to form the shell by welding or brazing the front flange to the back flange.

37. The assembly of claim 29, wherein the tool has a hole in the surface, further comprising an insert rod received in the hole.

38. The assembly of claim 37, wherein spaces are defined between the insert rod and an interior wall of the hole.

39. An assembly comprising:

a tool having a surface;

a sheet metal shell covering at least a portion of the surface and defining a cavity between the shell and the surface, the shell further having an opening to an exterior of the shell; and

a plurality of spacers engaging the tool and the shell and separating the tool from the shell.

40. The assembly of claim 39, wherein the assembly is configured for forming a wear resistant composite coating on the surface by filling the cavity with a hard particulate material, placing a metallic brazing material in communication with the cavity, heating the assembly to a temperature above a melting point of the brazing material and holding the temperature for a time sufficient for the brazing material to infiltrate the particulate material in molten form and contact the surface of the tool, and cooling the assembly to solidify the matrix material and form the wear resistant composite coating on the surface.

41. The assembly of claim 40, further comprising a wall extending from the shell and defining a reservoir connected to the shell and positioned outside the cavity in communication with the opening, wherein the reservoir is configured to have a brazing material placed therein to be in communication with the cavity.

42. The assembly of claim 39, further comprising a composite material filling the cavity and forming a coating on at least a portion of the surface of the tool, the composite material comprising a hard particulate material infiltrated with a metallic brazing material, wherein the brazing material is bonded to the surface.

43. An article comprising:

a substrate having a surface;

a metal shell connected to the substrate to define a cavity between the surface of the substrate and the shell;

a hard material positioned within the cavity; and

a metallic brazing material bonding the hard material to the surface of the substrate.

44. The article of claim 43, wherein the shell has an opening to an exterior of the shell, and wherein the composite material is exposed to the exterior of the shell through the opening.

45. The article of claim 44, further comprising a flared reservoir connected to the shell and positioned outside the cavity in communication with the opening.

46. The article of claim 43, wherein the shell is connected to the surface of the substrate by welding or brazing.

47. The article of claim 46, wherein the shell further comprises a conformal band in surface-to-surface contact with a portion of the surface of the substrate around an entire periphery of the shell, wherein the shell is connected to the substrate by welding or brazing at least at the conformal band.

48. The article of claim 47, wherein the substrate has a bonding surface in surface-to-surface contact with the conformal band, and wherein at least a portion of the substrate within the cavity is inset with respect to the bonding surface.

49. The article of claim 43, wherein the brazing material is further bonded to the shell.

50. The article of claim 43, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a back piece having a back flange extending transversely from a front edge of the back piece, wherein the front piece and the back piece are joined together to form the shell by welding or brazing the front flange to the back flange.

51. The article of claim 43, wherein the hard material and the metallic brazing material form a composite hardfacing material covering the surface of the substrate.

52. The article of claim 51, wherein the hard material has a porous structure that is infiltrated by the metallic brazing material to form the composite hardfacing material.

53. The article of claim 51, wherein the hard material comprises a particulate material that is infiltrated by the metallic brazing material to form the composite hardfacing material.

54. The article of claim 43, wherein the shell is formed of sheet metal.

55. A method comprising:

connecting a metal shell to a surface of a substrate to define a cavity between the shell and the surface;

placing a hard material within the cavity;

placing a metallic brazing material in communication with the cavity;

heating the brazing material to a temperature above a melting point of the brazing material and holding the temperature for a time sufficient for the brazing material to contact the hard material and the surface of the substrate in molten form; and

cooling the brazing material to solidify the brazing material and bond the hard material to the surface of the substrate.

56. The method of claim 55, wherein the shell has an opening to an exterior of the shell and a reservoir is connected to the shell and positioned outside the cavity in communication with the opening, and wherein the brazing material is placed within the reservoir to be in communication with the cavity.

57. The method of claim 55, wherein connecting the shell to the substrate comprises welding or brazing the shell to the surface of the substrate.

58. The method of claim 57, wherein the shell further comprises a conformal band extending around a periphery of the shell, and wherein connecting the shell to the substrate comprises welding or brazing the conformal band to the surface of the substrate, such that the conformal band is in surface-to-surface contact with a portion of the surface of the substrate around the entire conformal band.

59. The method of claim 55, wherein the brazing material is bonded to the shell after the brazing material is solidified.

60. The method of claim 55, wherein the shell comprises a front piece having a front flange extending transversely from a back edge of the front piece and a back piece having a back flange extending transversely from a front edge of the back piece, wherein the method further comprises joining the front piece and the back piece together to form the shell by welding or brazing the front flange to the back flange.

61. The method of claim 55, wherein the particulate material comprises tungsten carbide, and the metallic brazing material comprises Ni-Cr-Si-B brazing alloy, and wherein the brazing material is heated to a temperature of approximately 2050°F for a time of approximately 30 to 60 minutes.

62. The method of claim 55, further comprising welding or brazing pieces of sheet metal together to form the shell.

63. The method of claim 55, wherein the hard material and the metallic brazing material form a composite hardfacing material covering the surface of the substrate.

64. The method of claim 63, wherein the hard material has a porous structure that is infiltrated by the metallic brazing material in molten form to form the composite hardfacing material.

65. The method of claim 63, wherein the hard material comprises a particulate material that is infiltrated by the metallic brazing material in molten form to form the composite hardfacing material.

66. The method of claim 55, wherein the shell is formed of sheet metal.

67. An assembly comprising:

a substrate having a surface; and

a metal shell connected to the substrate to define a cavity between the surface and the shell, the shell further having an opening to an exterior of the shell.

68. The assembly of claim 67, wherein the shell is formed of sheet metal.

69. The assembly of claim 67, wherein the shell is connected to the substrate by welding or brazing the shell to the surface.

70. The assembly of claim 67, wherein the shell has a conformal band conforming to at least a portion of the surface.

71. The assembly of claim 70, wherein the shell is connected to the substrate by welding or brazing the conformal band to the at least a portion of the surface.

72. The assembly of claim 67, wherein the assembly is configured for forming a wear resistant composite coating on the surface by filling the cavity through the opening with a hard particulate material, placing a metallic brazing material in

communication with the cavity, heating the assembly to a temperature above a melting point of the brazing material and holding the temperature for a time sufficient for the brazing material to infiltrate the particulate material in molten form and contact the surface of the tool, and cooling the assembly to solidify the matrix material and form the wear resistant composite coating on the surface.