CLAIMS

1. A component comprising:

a component body including at least a first section of a first material and a second section of a second material that differs from the first material in composition, the first section and the second section being metallurgically bonded to each other in a boundary zone (540; 540-1, 540-2) having a mixture of the first material and the second material wherein the component body further comprises:

a third section of a third material that differs from the first material and the second material, the third section and the second section being metallurgically bonded to each other in a boundary zone (540-2; 540-1) having a mixture of the third material and the second material and wherein

the first material is a Group C alloy of Table I or an alloy having a compositional range for a Group C alloy above;

the second material is a Group A alloy of Table I or an alloy having a compositional range for a Group A alloy above; and

the third material comprises by weight percent:

nickel as a largest content;

4.5-8.5 Cr;

0.5-1.5 Mo;

2.5-3.5 W;

1.5-2.5 Ta;

5.5-7.5 Al;

4.5-5.5 Co;

0-4 Re; and

0.05-0.20 Hf.

2. A method of casting, comprising:

introducing a first molten alloy into a mold (210);

partially solidifying the first molten alloy to form a solidified section, with a remaining molten portion on the solidified section; and

introducing a second molten alloy into the mold such that the remaining molten portion and the second molten alloy at least partially mix, the first molten alloy and

second molten alloy differing in chemistry wherein the introduction of the second molten alloy comprises:

a first pour of the second molten alloy whereafter the mixture is solidified; and

a second pour onto the solidified mixture and solidifying to form another solidified section such that the solidified mixture metallurgically bonds the solidified sections together, and

wherein first molten alloy comprises by weight percent:

nickel as a largest content;

4.5-8.5 Cr;

0.5-1.5 Mo;

2.5-3.5 W;

1.5-2.5 Ta;

5.5-7.5 Al;

4.5-5.5 Co;

0-4 Re; and

0.05-0.20 Hf.

3. The method of claim 2 wherein the introduction of the second molten alloy is a continuous pour of the second molten alloy to both form the mixture and form a further portion after solidifying the mixture.

4. A blade (60; 60-2; 60-3) comprising:

an attachment root (63); and

an airfoil (61), the airfoil having a proximal end (68) and a distal end (69), wherein the blade has a compositional change between a first zone and a second zone, with a crystalline structure extending across the first zone and second zone wherein the blade has a density variation of at least 3% between the first zone and the second zone, and wherein a less dense of the first zone and the second zone comprises by weight percent:

nickel as a largest content;

4.5-8.5 Cr;

0.5-1.5 Mo;

2.5-3.5 W;

1.5-2.5 Ta;

5.5-7.5 Al;

4.5-5.5 Co;

0-4 Re; and

0.05-0.20 Hf.

5. A method of casting a blade (60; 60-2; 60-3), the blade having an attachment root (63) and an airfoil (61), the airfoil having a proximal end (68) and a distal end (69), the method comprising:

introducing a molten alloy into a mold (210); and

varying a composition of the introduced alloy during the introduction so as to produce a compositional variation wherein the compositional variation includes variation along the airfoil, and

wherein said variation is such that an outboard portion of the blade comprises by weight percent:

nickel as a largest content;

4.5-8.5 Cr;

0.5-1.5 Mo;

2.5-3.5 W;

1.5-2.5 Ta;

5.5-7.5 Al;

4.5-5.5 Co;

0-4 Re; and

0.05-0.20 Hf.

6. The method of claim 5 wherein the compositional variation provides the outboard portion of the blade (80; 80-2) with a lower density than an inboard portion of the blade (82; 82-2).

7. The method of claim 5 wherein the compositional variation provides the outboard portion of the airfoil with a lower density than an inboard portion of the airfoil.

8. The method of claim 5 wherein the compositional variation provides three compositional zones (80-2, 81, 82-2) with transitions (540, 540-2) between adjacent zones.

9. The method of claim 8 wherein the three compositional zones comprise a first zone (82-2) at least partially along the attachment root, a second zone (81) at least partially along the airfoil and a third zone (80-2) outboard of the second zone, wherein the third zone is the outboard portion of the blade.

10. The method of claim 9 wherein the first zone is formed by a Group C alloy of Table I or by an alloy having a compositional range for a Group C alloy above; and the second zone is formed by a Group A alloy of Table I or by an alloy having a compositional range for a Group A alloy above.

11. The method of claim 5 wherein the blade has a shroud (88) at the airfoil distal end; and
at least a portion of the shroud has a lower density than at least a portion of the airfoil, and wherein the portion of the shroud is the outboard portion of the blade.

12. The method of claim 5 wherein the blade comprises a nickel-base superalloy.

13. The method of claim 5 wherein the blade comprises a single crystal or directionally solidified columnar grain microstructure extending across two zones of different composition and a transition therebetween.

14. The method of claim 5 wherein the blade has a density variation of at least 3%.

15. The method of claim 5 wherein the blade has a density variation of 6-10%.

16. The method of claim 5 wherein the introducing and varying comprise:
a bottom-feed pour followed by at least one top-feed pour.

17. The method of claim 5 wherein the introducing and varying comprise:

~~a series of top feed pours without any bottom feed pour.~~

~~18. The method of claim 5 wherein the introducing and varying comprise:~~
~~introducing a first alloy to a mold cavity via along a first flow path (270) through a first port (272); and~~
~~introducing a second alloy, differing in composition from the first alloy, to the mold cavity along a second flow path (280) through a second port (282) but not through the first port, and~~
~~wherein the varying only occurs for the first alloy such that it comprises by weight percent:~~
~~nickel as a largest content;~~
~~4.5-8.5 Cr;~~
~~0.5-1.5 Mo;~~
~~2.5-3.5 W;~~
~~1.5-2.5 Ta;~~
~~5.5-7.5 Al;~~
~~4.5-5.5 Co;~~
~~0-4 Re; and~~
~~0.05-0.20 Hf.~~

~~19. The method of claim 18 wherein the first flow path and second flow path partially overlap along a portion of a downsprue (260).~~

~~20. The method of claim 18 wherein the first flow path passes through a grain starter (256) and the second flow path bypasses the grain starter.~~

~~21. The method of claim 18 wherein the first alloy has solidified to block the first port by the time the second alloy is introduced.~~

~~22. The method of claim 18 wherein the introducing and varying further comprise:~~
~~introducing a third alloy, differing in composition from the first alloy and second alloy, to the mold cavity along a third flow path through a third port but not through the first port or second port.~~

~~23. The component of claim 1 or the method of claim 2 or the method of claim 5 wherein, respectively the third material or the first molten alloy or the outboard portion is an alloy which comprises by weight percent:~~

~~5-8 said Cr; and~~

~~0.5-1.0 said Mo.~~

~~24. The component of claim 1 or the method of claim 2 or the method of claim 5 wherein, respectively the third material or the first molten alloy or the outboard portion is an alloy which consists essentially of nickel as a largest content;~~

~~4.5-8.5 Cr;~~

~~0.5-1.5 Mo;~~

~~2.5-3.5 W;~~

~~1.5-2.5 Ta;~~

~~5.5-7.5 Al;~~

~~4.5-5.5 Co;~~

~~0-4 Re; and~~

~~0.05-0.20 Hf.~~

~~25. The component of claim 1 or the method of claim 2 or the method of claim 5 wherein, respectively the third material or the first molten alloy or the outboard portion is an alloy which further comprises no more than trace amounts of other elements, if any.~~

~~26. The component of claim 1 or the method of claim 2 or the method of claim 5 wherein, respectively the third material or the first molten alloy or the outboard portion is used along a first portion of a blade airfoil, with a denser and/or less oxidation resistant alloy along a second portion of the airfoil inboard of the first portion.~~

~~27. The component of claim 1 or the method of claim 2 or the method of claim 5 wherein, respectively the third material or the first molten alloy or the outboard portion is used along a first portion of a blade airfoil, with an at least 5% denser alloy along a second portion of the airfoil inboard of the first portion.~~

~~28. The component of claim 1 or the method of claim 2 or the method of claim 5 wherein, respectively the third material or the first molten alloy or the outboard portion is an alloy which comprises, by weight percent:~~

~~nickel as a largest content;~~

~~5-8 Cr;~~

~~0.5-1.0 Mo;~~

~~2.5-3.5 W;~~

~~1.5-2.5 Ta;~~

~~5.5-7.5 Al;~~

~~4.5-5.5 Co;~~

~~0-4 Re; and~~

~~0.05-0.20 Hf.~~

1. A method of casting, comprising:

introducing via a pour cup a first molten alloy into a mold, a downsprue extending downwardly from a base of the pour cup;

partially solidifying the first molten alloy to form a solidified section and block the downsprue, with a remaining molten portion on the solidified section; and

introducing via said pour cup a second molten alloy into the mold such that the remaining molten portion and the second molten alloy at least partially mix, the first molten alloy and second molten alloy differing in chemistry.

2. The method of claim 1 wherein:

the introduction of the second molten alloy is a continuous pour of the second molten alloy to both form the mixture and form a further portion after solidifying the mixture.

3. The method of claim 1 wherein:

the introduction of the second molten alloy comprises:

a first pour of the second molten alloy whereafter the mixture is solidified; and

a second pour onto the solidified mixture and solidifying to form another solidified section such that the solidified mixture metallurgically bonds the solidified sections together.

4. A method of casting a blade, the blade having an attachment root and an airfoil, the airfoil having a proximal end and a distal end, the method comprising:

introducing a molten alloy into a mold through a pour cup and a downsprue extending downwardly from a base of the pour cup; and

varying a composition of the introduced alloy during the introduction so as to produce a compositional variation, the compositional variation providing a density variation of at least 3%,

wherein:

the introducing and varying comprise:

a bottom-feed pour followed by at least one top feed pour, both through a single said pour cup, said top feed pour being introduced on or atop an at least partially solidified section of said molten alloy that locally blocks the downsprue.

5. The method of claim 4 wherein:

the compositional variation includes variation along the airfoil.

6. The method of claim 4 wherein:

the compositional variation provides an outboard portion of the blade with a lower density than an inboard portion of the blade.

7. The method of claim 4 wherein:

the compositional variation provides an outboard portion of the airfoil with a lower density than an inboard portion of the airfoil.

8. The method of claim 4 wherein:

the compositional variation provides three compositional zones with transitions between adjacent zones.

9. The method of claim 8 wherein:

the three compositional zones comprise a first zone at least partially along the attachment root, a second zone at least partially along the airfoil and a third zone outboard of the second zone.

10. The method of claim 4 further comprising:
at least partially during the introduction, cooling the mold so as to solidify the introduced alloy to form said at least partially solidified section, the varying occurring at least partially during the solidifying.

11. The method of claim 4 wherein:
the blade has a shroud at the airfoil distal end;
at least a portion of the shroud has a lower density than at least a portion of the airfoil.

12. The method of claim 4 wherein:
the blade comprises a nickel-base superalloy.

13. The method of claim 4 wherein:
the blade comprises a single crystal or directionally solidified columnar grain microstructure extending across two zones of different composition and a transition therebetween.

14. The method of claim 4 wherein:
the blade has a density variation of 6-10%.

15. A method of casting a blade, the blade having an attachment root and an airfoil, the airfoil having a proximal end and a distal end, the method comprising:
introducing a molten alloy into a mold; and
varying a composition of the introduced alloy during the introduction so as to produce a compositional variation,
wherein:
the introducing and varying comprise:
introducing a first alloy to a mold cavity along a first flow path through a first port; and
introducing a second alloy, differing in composition from the first alloy, to the mold cavity along a second flow path through a second port but not through the first port, wherein the first flow path and second flow path overlap along a portion of a downsprue; and
the first alloy has solidified in the downsprue to block the first port by the time the second alloy is introduced.

16. The method of claim 15 wherein:
the first flow path and second flow path overlap from a pour cup.

17. The method of claim 15 wherein:
the first flow path passes through a grain starter and the second flow path bypasses the grain starter.

18. The method of claim 15 wherein:
the introducing and varying further comprise:
introducing a third alloy, differing in composition from the first alloy and second alloy, to the mold cavity along a third flow path through a third port but not through the first port or second port.