

Claims

1. A biodegradable alloy of Formula (I):

5 Mg-Zn-X -- Formula (I)

wherein:

X represents -Ca-Mn or -Dy-Sr;

Mg is magnesium, Zn is zinc, Dy is dysoprium, Sr is strontium, Ca is calcium and Mn is manganese;

10 wherein said alloy comprises, based on total alloy weight:

about 0.1 wt% to about 3.0 wt% Zn;
about 0.1 wt% to about 0.7 wt% Dy;
about 0.1 wt% to about 0.9 wt% Sr;
about 0.1 wt% to about 1.5 wt% Ca;
about 0.1 wt% to about 0.9 wt% Mn; and
balance of Mg and impurities.

2. The alloy of claim 1, wherein the alloy is of Formula (IA):

Mg-Zn-Ca-Mn

3. The alloy of claim 1, wherein the alloy is of Formula (IB):

Mg-Zn-Dy-Sr

4. The alloy of any one of the preceding claims, wherein the alloy comprises zinc at about 2.0 wt% to about 2.5 wt%.

5. The alloy of any one of claims 1, 2, or 4, wherein the alloy comprises calcium at about 0.5 wt% to about 1.0 wt%.

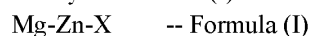
6. The alloy of any one of claims 1, 2, 4 or 5, wherein the alloy comprises manganese at about 0.2 wt% to about 0.8 wt%.

7. The alloy of any one of claims 1, 3, or 4, wherein the alloy comprises dysprosium at about 0.4 wt% to about 0.6 wt%.

8. The alloy of any one of claims 1, 3, 4 or 7, wherein the alloy comprises strontium at about 0.2 wt% to about 0.8 wt%.

9. The alloy of any one of the preceding claims, wherein the alloy is selected from the group consisting of:
- 5
- Mg-Zn-Ca-Mn, wherein Zn is 2.5 wt%, Ca is 1.0 wt%, Mn is 0.3 wt% and Mg makes up the balance;
 - Mg-Zn-Ca-Mn, wherein Zn is 2.5 wt%, Ca is 1.0 wt%, Mn is 0.5 wt% and Mg makes up the balance;
 - Mg-Zn-Ca-Mn, wherein Zn is 2.5 wt%, Ca is 1.0 wt%, Mn is 0.7 wt% and Mg makes up the balance.
- 10
- Mg-Zn-Dy-Sr, wherein Zn is 2.5 wt%, Dy is 0.5 wt%, Sr is 0.2 wt% and Mg makes up the balance;
 - Mg-Zn-Dy-Sr, wherein Zn is 2.5 wt%, Dy is 0.5 wt%, Sr is 0.5 wt% and Mg makes up the balance; and
- 15
- Mg-Zn-Dy-Sr, wherein Zn is 2.5 wt%, Dy is 0.5 wt%, Sr is 0.8 wt% and Mg makes up the balance.
10. The alloy of any one of the preceding claims, wherein the alloy further comprises impurities selected from the group consisting of aluminum, iron, nickel, silicon and copper.
- 20
11. The alloy of claim 10, wherein the impurities constitute 20 ppm or less.
12. The alloy of any one of the preceding claims, wherein the alloy does not contain aluminum or yttrium.
- 25
13. An implant comprising the alloy of any one of claims 1 to 12.
14. The implant of claim 13, wherein the implant is a neurosurgical, cranial, maxillofacial, orthopedic or dental implant.
- 30
15. A method for producing an alloy comprising:
- (a) placing alloy components in a crucible, wherein the alloy components are placed in the crucible in a multilayer arrangement;
 - (b) melting the alloy components at about 700 °C to about 850 °C;
 - (c) stirring the melt of step (b) at about 400 rpm to about 500 rpm;
 - (d) atomizing the melt of step (c) into millimeter size droplets using jets of inert gas;
 - (e) cooling and depositing the atomized alloy melt to obtain an ingot.
- 35
- 40

16. A method for producing an alloy of Formula (I):



wherein:

X represents –Ca-Mn or –Dy-Sr;

5 Mg is magnesium, Zn is zinc, Dy is dysoprium, Sr is strontium, Ca is calcium and Mn is manganese;

wherein said alloy comprises, based on total weight:

10 about 0.1 wt% to about 3.0 wt% Zn;
about 0.1 wt% to about 0.7 wt% Dy;
about 0.1 wt% to about 0.9 wt% Sr;
about 0.1 wt% to about 1.5 wt% Ca;
about 0.1 wt% to about 0.9 wt% Mn; and
balance of Mg and impurities,

wherein said method comprises:

15 (a) placing alloy components in a crucible, wherein the alloy components are placed in the crucible in a multilayer arrangement;
(b) melting the alloy components at about 700 °C to about 850 °C;
(c) stirring the melt of step (b) at about 400 rpm to about 500 rpm;
20 (d) atomizing the melt of step (c) into millimeter size droplets using jets of inert gas;
(e) cooling and depositing the atomized alloy melt to obtain an ingot.

17. The method of claim 15 or 16, wherein step (a) comprises controlling the volume of the alloy components to 70% to 75% the volume of the crucible.

25 18. The method of any one of claims 15 to 17, wherein the multilayer arrangement of step (a) comprises an A-B-A arrangement, wherein A consists of a first alloy component and B consists of a second alloy component, wherein the first and second alloy components may each consist of a single alloy material or a
30 blended alloy mixture of two or more alloy materials.

19. The method of any one of claims 15 to 18, wherein the multilayer arrangement of step (a) comprises an A-B-A-B-A arrangement, wherein A consists of a first alloy component and B consists of a second alloy component, wherein
35 the first and second alloy components may each consist of a single alloy material or a blended alloy mixture of two or more alloy materials.

20. The method of claim 18 or 19, wherein A consists of magnesium and B consists of a blended alloy mixture of zinc and X.
- 5 21. The method of any one of claims 1-20, wherein each layer of the multilayer arrangement is of substantially equal volume.
22. The method of any one of claims 15 to 21, wherein step (d) comprises using 2 to 4 jets of inert gas.
- 10 23. The method of any one of claims 15 to 22, wherein the inert gas in step (d) is argon.
24. The method of any one of claims 15 to 23, wherein the diameter of each jet in step (d) is about 1 mm to about 2 mm.
- 15 25. The method of any one of claims 15 to 24, wherein the gas flow rate in step (d) is about 20 to about 30 litres per minute.
26. The method of any one of claims 15 to 25, further comprising step (f) 20
subjecting the ingot to hot extrusion at about 250 °C to about 400 °C.
27. The method of claim 26, wherein the extrusion ratio range is 25:1 to 12:1.

25

30