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(54) Title: MAGNESIUM ALLOY, PREPAIRING METHOD AND USE THEREOF

(57) Abstract: A magnesium alloy is provided, based on a total weight of the magnesium alloy, comprising: about 0.2-1.35wt %of Al; about 0.05-3wt %of Mn; about 0.1-2wt %of Si; about 0-0.005wt %of Fe; about 0-0.01wt %of Cu; about 0-0.01wt %of Ni; about 0-0.01wt %of Co; about 0-1wt %of a rare earth element; about 0-1wt %of Zn; about 0-0.1wt %of Be; about 0-1wt %of Zr; about 0-0.005wt %of Ca; 0-0.005wt %of Sn: and about 90.505-99.65wt %of Mg.

MAGNESIUM ALLOY, PREPAIRING METHOD AND USE THEREOF

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and benefits of Chinese Patent Application No. 201410305840.9, filed with the State Intellectual Property Office of P. R. China on June 30, 2014, the entire content of which is incorporated herein by reference.

FIELD

The present disclosure relates to alloys, more particularly relates to a magnesium alloy and a method of preparing the magnesium alloy.

BACKGROUND

Magnesium (hereinafter, magnesium may be referred to as "Mg") has significant features such as light weight to be used in all of the engineering metals, and small density of 1.78 g/cm^3, which is about 2/9 of that of steel and 2/3 of that of aluminum (hereinafter, aluminum may be referred to as "Al"), and Mg is the lightest metal material with an engineering application value at present. In addition, a magnesium alloy has a relative high specific strength, a relative high specific stiffness, a better shock resistance performance and a higher resistance to radiation. As electronic products become thinner and lighter and functions thereof become more and more diverse, a magnesium alloy with a high strength and high heat conductivity becomes an important candidate among structure materials.

At present, a conventional die casting magnesium alloy for electronic products relates to AZ91 series alloy, which has a good casting property and mechanical strength, and the strength thereof may be superior to that of ZL104 aluminum alloy, thus being applied widely. However, the heat conductivity coefficient of AZ91 series alloy is only about 70 W/(m•K), far less than the heat conductivity of 100 W/(m•K) to cast aluminum alloy. Therefore, use of magnesium alloy with a low heat conductivity as a component of the electronic product may greatly influence the heat dissipation requirement on the electronic product.

In addition, as a structure component of the electronic product, a magnesium alloy may need a relatively good corrosion resistance to meet processing requirements and the usage requirement.

SUMMARY

Embodiments of the present disclosure seek to solve at least one of the problems existing in the prior art to at least some extent, such as low heat conductivity coefficient. Accordingly, the present disclosure aims to provide a magnesium alloy with not only strong mechanical property but also excellent corrosion resistance and high heat conductivity coefficient.

According to a first aspect of the present disclosure, there is provided a magnesium alloy, based on a total weight of the magnesium alloy, comprising: about 0.2-1.35wt% of Al; about 0.05-3wt% of Mn; about 0.1-2wt% of Si; about 0-0.005wt% of Fe; about 0-0.01wt% of Cu; about 0-0.01wt% of Ni; about 0-0.01wt% of Co; about 0-1wt% of a rare earth element; about 0-1wt% of Zn; about 0-0.1wt% of Be; about 0-1wt% of Zr; about 0-0.005wt% of Ca; 0-0.005wt% of Sn; and about 90.505-99.65wt% of Mg.

According to a second aspect of the present disclosure, there is provided a magnesium alloy, based on a total weight of the magnesium alloy, comprising: about 0.2-1.35wt% of Al; about 0.05-3wt% of Mn; about 0.1-2wt% of Si; about 0-0.005wt% of Fe; about 0-0.01wt% of Cu; about 0-0.01wt% of Ni; about 0-0.01wt% of Co; about 0-1wt% of a rare earth element; about 0-1wt% of Zn; about 0-0.1wt% of Be; about 0-1wt% of Zr; about 0-0.005wt% of Ca; about 0-0.005wt% of Sn; and a balance of Mg.

According to a third aspect of the present disclosure, there is provided a method of preparing a magnesium alloy, comprising: smelting and cooling a raw material of the magnesium alloy, in which, the raw material has a composition of the magnesium alloy capable of forming a magnesium alloy above-mentioned.

According to a fourth aspect of the present disclosure, there is provided use of the above-mentioned magnesium alloy according to embodiments of the present disclosure as a heat conducting material.

According to embodiments of the present disclosure, the magnesium alloy has not only relative high strength and hardness, but also relative high ductility, which may be able to form a structure component with various kinds of shapes and thickness. It's more important that, according to

embodiments of the present disclosure, the magnesium alloy has a good heat conductivity coefficient, which may be above 100 W/(m • K), even achieve about 120 W/(m • K). Meanwhile, the magnesium alloy of embodiments of the present disclosure has a good corrosion resistance, which may meet the requirements of various processing methods and operating environment.

According to embodiments of the present disclosure, the magnesium alloy is suitable to be used as a structure material which may require a high heat-conducting property, especially as a structure component of electronic products.

Additional aspects and advantages of embodiments of present disclosure will be given in part in the following descriptions, become apparent in part from the following descriptions, or be learned from the practice of the embodiments of the present disclosure.

DETAILED DESCRIPTION

Reference will be made in detail to embodiments of the present disclosure. The embodiments described herein are explanatory, illustrative, and used to generally understand the present disclosure. The embodiments shall not be construed to limit the present disclosure.

According to a first aspect of the present disclosure, there is provided a magnesium alloy, and based on a total weight of the magnesium alloy, the magnesium alloy comprises:

about 0.2-1.35wt% of Al;

about 0.05-3wt% of Mn;

about 0.1-2wt% of Si;

about 0-0.005wt% of Fe;

about 0-0.01wt% of Cu;

about 0-0.01wt% of Ni;

about 0-0.01wt% of Co;

about 0-1wt% of a rare earth element;

about 0-1wt% of Zn;

about 0-0.1wt% of Be;

about 0-1wt% of Zr;

about 0-0.005wt% of Ca;

about 0-0.005wt% of Sn; and

about 90.505-99.65wt% of Mg.

According to some embodiments of the present disclosure, there is provided a magnesium alloy, comprising: based on the total weight of the magnesium alloy, 0.2-1.35wt% of Al; 0.05-3wt% of Mn; 0.1-2wt% of Si; 0-0.005wt% of Fe; 0-0.01wt% of Cu; 0-0.01wt% of Ni; 0-0.01wt% of Co; 0-1wt% of a rare earth element; 0-1wt% of Zn; 0-0.1wt% of Be; 0-1wt% of Zr; 0-0.005wt% of Ca; 0-0.005wt% of Sn; and a balance of Mg.

According to embodiments of the present disclosure, the magnesium alloy includes Al element. With the Al element in the magnesium alloy, all of the casting property, the corrosion resistance and the mechanical property of the magnesium alloy may be improved. However, if the content of Al element in the magnesium alloy is too large, the heat conductivity coefficient of the magnesium alloy will be reduced significantly. Therefore, in order to make use of Al element of its advantages such as excellent casting property, corrosion resistance and mechanical property without reducing the heat-conducting property of the magnesium alloy, based on the total weight of the magnesium alloy, the content of Al element in the magnesium alloy ranges from 0.2wt% to 1.35wt%. In order to further improve the heat-conducting property of the magnesium alloy under this premise of ensuring an excellent mechanical property and corrosion resistance of the magnesium alloy, based on the total weight of the magnesium alloy, the content of Al element in the magnesium alloy may range from 0.5wt% to 1wt%.

According to embodiments of the present disclosure, the magnesium alloy includes Si element. Si element and the Mg element in the magnesium alloy may form Mg_2Si, so that the magnesium alloy may have a relative high hardness and a relative low expansion coefficient, thus improving the mechanical property of the magnesium alloy. In addition, with the addition of Si element, the casting property of the magnesium alloy may be improved significantly. But if the content of the Si element is too large, it will bring some negative influences on the heat-conducting property and the corrosion resistance of the magnesium alloy. According to embodiments of the present disclosure, based on the total weight of the magnesium alloy, the content of Si element ranges from 0.1wt% to 2wt%, alternatively from 1wt% to 2wt%. Thus the magnesium alloy may have not only an excellent

heat-conducting property, a high hardness and a high strength, but also a good corrosion resistance.

According to embodiments of the present disclosure, the magnesium alloy includes Mn element. With the addition of the Mn element in the magnesium alloy, the corrosion resistance of the magnesium alloy may be improved, and the Mn element in the magnesium alloy may act with the Fe element in the magnesium alloy to form a sediment with a high melting point to precipitate out, therefore the melt of the magnesium alloy may be cleaner. Meanwhile, the Mn element with an appropriate content may improve the casting property of the magnesium alloy. But if the content of the Mn element is too large, the heat-conducting property of the magnesium alloy will reduce significantly. In some embodiments of the present disclosure, based on the total weight of the magnesium alloy, the content of the Mn element ranges from 0.05wt% to 3wt%, alternatively from 0.4wt% to 2.6wt%.

The rare earth element in the magnesium alloy may expand the crystallization temperature interval of the alloy, therefore the casting property of the magnesium alloy may be improved significantly. Meanwhile, the rare earth element in the magnesium alloy has a relative high solid solubility, and may precipitate out a strengthen phase along with a decrease of temperature after smelting. Therefore, with the addition of the rare earth element, the yield strength and the casting property of the magnesium alloy may be improved. While, with the addition of a superfluous rare earth element, the heat conductivity coefficient of the magnesium alloy may be decreased, and the corrosion resistance of the magnesium alloy may get worse. In some embodiments of the present disclosure, the magnesium alloy may include rare earth element, based on the total weight of the magnesium alloy, the content of the rare earth element may below 1wt%. In some embodiments of the present disclosure, based on the total weight of the magnesium alloy, the content of the rare earth element ranges from 0.2wt% to 0.5wt%, thus further improving the corrosion resistance of the magnesium alloy, meanwhile, the magnesium alloy may have a relative high heat conductivity coefficient. In some embodiments of the present disclosure, the rare earth element may be at least one selected from a group consisted of Y, Sc, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu. The inventors of the present disclosure have found, after long-time experimentation, that, when the rare earth element is selected from at least one selected from a group consisted of Ce, Y and Nd, the exist of an appropriate amount of the rare earth element may obtain a magnesium

alloy with a better casting property and solution strengthening property and a higher strength, without an obvious negative influence on the heat conductivity coefficient of the magnesium alloy.

Zn element in the magnesium alloy may improve solid solubility of Al element in the magnesium alloy. In addition, Zn is a metal with a low melting point that may significantly decrease the melting point of the alloy and then improve the casting property of the magnesium alloy. But, a superfluous Zn may significantly make influence on the heat conducting property and corrosion resistance, thus decreasing the ductility of the magnesium alloy. Therefore, in some embodiments of the present disclosure, based on the total weight of the magnesium alloy, the content of Zn element is below 1wt%. In some embodiments of the present disclosure, based on the total weight of the magnesium alloy, the content of Zn element ranges from 0.1wt% to 0.5wt%, alternatively, from 0.3wt% to 0.5wt%.

Be element in the magnesium alloy may form a compact BeO on the surface of the magnesium alloy melt, fill into the loose MgO layer, and decrease the surface contact between the magnesium alloy and the outside world. Be element is an important flame retardant for pressure casting the magnesium alloy, and a small quantity of Be element may improve the metallurgical property of the magnesium alloy substantially. Due to that Be element is expensive and the steam and oxide thereof is harmful to people's health, the content of Be should be controlled appropriately. Meanwhile, a superfluous may decrease the ductility of the magnesium alloy. In some embodiments of the present disclosure, based on the total weight of the magnesium alloy, the content of Be element is below 0.1wt%. In some embodiments of the present disclosure, based on the total weight of the present disclosure, the content of Be ranges from 0.01wt% to 0.05wt%. In some embodiments of the present disclosure, based on the total weight of the present disclosure, the content of Be element in the magnesium alloy ranges from 0.03wt% to 0.05wt%.

Zr is an important alloying element, which may act with iron compound to form Zr_2Fe_2 and Zr_2Fe_3 alloy, so as to precipitate out iron from the alloy before casting, thus improving the purity and the corrosion resistance of the magnesium alloy. Meanwhile, Zr may refine the magnesium alloy grain significantly and improve the mechanical property of the magnesium alloy, but when Zr element is added excessively, the cost of the magnesium alloy may be increased and the overall performance of the magnesium alloy may be influenced. In some embodiments of the present

disclosure, based on the total weight of the present disclosure, the content of Zr is below 1wt%, alternatively from 0.1wt% to 0.5wt%. In some embodiments of the present disclosure, based on the total weight of Zr element, Zr ranges from 0.3wt% to 0.5wt%.

In one embodiment of the present disclosure, based on the total weight of the magnesium alloy, the magnesium alloy includes at least one of: 0.1-0.5wt% of Zn, 0.01wt%-0.05wt% of Be and 0.1wt%-0.5wt% of Zr.

Fe, Cu, Ni, Co, Sn and Ca may have negative influence on the corrosion resistance of the magnesium alloy, if the contents of the above elements are too large, the heat-conducting property may be influenced negatively. In some embodiments of the present disclosure, based on the total weight of the present disclosure, the content of Fe is below 0.005wt%; the content of Cu is below 0.01wt%, alternatively below 0.005wt%; the content of Ni is below 0.01wt%, alternatively below 0.005wt%; the content of Co is below 0.01wt%, alternatively below 0.005wt%; the content of Sn is below 0.005wt%; and the content of Ca is below 0.005wt%.

In some embodiments of the present disclosure, the magnesium alloy includes a small quantity of other metal elements, which may be at least one selected from a group consisted of Li, Na, K, Sr, Ba, Ga, In, Ge, Sb, Bi, V, Nb, Cr, Mo, W, Tc, Ru, Pd, Pt, Ag and Au. Based on the total weight of the present disclosure, the content of the above mentioned other metal elements may be below 1wt%, preferably below 0.5wt%, further preferably 0.2wt%.

Fe, Cu, Ni, Co, Sn, Ca and other metal elements may come from the impurity in the raw material of the magnesium alloy, or one raw material for preparing one consisting element of the magnesium alloy.

According to a second aspect of the present disclosure, there is provided a magnesium alloy, comprising: based on the total weight of the magnesium alloy, 0.2-1.35wt% of Al; 0.05-3wt% of Mn; 0.1-2wt% of Si; 0-0.005wt% of Fe; 0-0.01wt% of Cu; 0-0.01wt% of Ni; 0-0.01wt% of Co; 0-1wt% of a rare earth element; 0-1wt% of Zn; 0-0.1wt% of Be; 0-1wt% of Zr; 0-0.005wt% of Ca; 0-0.005wt% of Sn; and a balance of Mg.

In some embodiments of the present disclosure, the magnesium alloy may include at least one of the above other metal elements, or none.

The magnesium alloy may be prepared by a conventional method. In some embodiments of the

present disclosure, a method of preparing a magnesium alloy includes: smelting and cooling a raw material of the magnesium alloy, in which, the composition of the raw material is capable of forming a magnesium alloy according to embodiments of the present disclosure.

The compositions of the raw material and the method of preparing the magnesium alloy of the present disclosure may be known to the skilled in the art.

In some embodiments of the present disclosure, the smelting is performed at a temperature of 700°C to750°C, for about 20-60 minutes. In order to avoid the oxidation caused by a contact between the magnesium alloy melting and air, a covering agent is used to protect the melting when smelting. The covering agent may be any conventional covering agent in the field of smelting of the magnesium alloy, such as at least one of $MgCl_2$, KCl, NaCl and CaF_2. In order to further improve the uniform of the compositions of the magnesium alloy, a process of argon stirring is added, in which, argon is argon with a purity above 99.999%.

According to some embodiments of the present disclosure, the magnesium alloy has not only a good general mechanical performance, but also a yield strength larger than 75 MPa, generally between 100-145 MPa, and a ductility above 7%, generally between 7-10%. In addition, according to some embodiments of the present disclosure, the magnesium alloy has a good heat-conducting property which may achieve 100W/(m•K). Meanwhile, the magnesium alloy has a relative good corrosion resistance.

According to embodiments of the present disclosure, the magnesium alloy is suitable for using as a heat conducting structure material, such as parts of various kinds of electronic products.

The present disclosure will be described below in detail with reference to some non-limiting examples. The examples are provided for illustration only, which may not be construed as a limit to the present disclosure.

In the following Examples and Comparative Examples, magnesium alloys are prepared according to the following methods respectively, and the hardness, heat conductivity coefficient, tensile strength and corrosion resistance of each magnesium alloy is tested according to the following methods.

(1) The hardness of a magnesium alloy wafer with a diameter of 12.7 mm and a thickness of 3 mm is tested with a Vickers, with a pressure of 3kg for less than 15 seconds, for at least 3 times to

obtain an average value, that is the harness of the magnesium alloy with a unit of HV.

(2) The heat conductivity coefficient of each magnesium alloy wafer with a diameter of 12.7 mm and a thickness of 3mm is tested according to ASTME 1461-07, such as laser indeed method.

(3) The tensile strength of each magnesium alloy is tested according to ISO 6892-1. A magnesium alloy melt is injected into a mold cavity to obtain a tensile casting with a thickness of 3 mm, and the tensile strength of the tensile casting is tested with a universal testing machine, in which, the tensile strength is a limit of yielding resulting 0.2% residual deformation, and the ductility is breakage ductility.

(4) The corrosion resistance of each magnesium alloy is tested by the following method. The magnesium alloy is cast into a slice with a size of 100mm × 100mm × 1.5mm and immerged into 5wt% NaCl aqueous solution for 48 hours (i.e., 2 days). The corrosion speed is tested by a weight loss method and calculated according to the following formula: $V=(m_1-m_2)/(t \times s)$, in which, m_1 relates to the weight of the magnesium alloy sample before immerging, with a unit of mg; m_2 relates to the weight of the magnesium ally that has been washed and dried at a temperature of 120°C to a constant weight after immerging, with a unit of mg; t relates to immerging time, with a unit of day; s relates to surface area of the magnesium alloy, with a unit of cm^2; V relates to a corrosion speed, with a unit of $mg/(cm^2d)$.

Examples 1-25 are provided for illustrate the present disclosure.

Example 1

In this example, a magnesium alloy E1 was prepared.

Raw materials of the magnesium alloy were provided according to formula $Mg_{97.3}Al_{1.3}Si_1Mn_{0.4}$, in which those numbers indicated weight percentages of corresponding elements based on the total weight of the aluminum alloy. The raw materials were melted in a smelting furnace at a temperature of 720°C for 30 minutes and argon with a purity of 99.999% was added into the smelting furnace in the process of smelting to obtain a magnesium melt. The obtained magnesium melt was injected into a metal mold and dried to obtain a magnesium casting. Then hardness, heat conductivity coefficient, tensile strength, ductility and corrosion speed of the magnesium casting was tested and the results were recorded in the Table 1.

Examples 2-25

In this example, magnesium alloys E2-E25 were prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the magnesium alloy were provided according to formulas listed in Table 1. The results of hardness, heat conductivity coefficient, tensile strength, ductility and corrosion speed of the magnesium alloys E2-25 were recorded in Table 1.

Comparative examples 1-11

In this example, magnesium alloys CE1-CE11 were prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the magnesium alloy were provided according to formulas listed in Table 1. The results of hardness, heat conductivity coefficient, tensile strength, ductility and corrosion speed of the magnesium alloys CE1-CE11 were recorded in Table 1.

Table 1

	composition/wt%	hardness /HV	heat conductivity coefficient /W/(m • K)	Tensile strength/MPa	ductility /%	Corrosion speed/mg/(cm^2 • d)
Example 1	$Mg_{97.3}Al_{1.3}Si_1Mn_{0.4}$	65	105	130	8	7
Example 2	$Mg_{97.6}Al_1Si_1Mn_{0.4}$	60	125	120	10	9
Example 3	$Mg_{98.5}Al_{0.5}Si_{0.5}Mn_{0.5}$	55	140	115	12	8
Example 4	$Mg_{97.25}Al_{1.35}Si_1Mn_{0.4}$	65	100	135	8	7
Example 5	$Mg_{96.6}Al_1Si_2Mn_{0.4}$	70	120	125	7	10
Example 6	$Mg_{95.4}Al_1Si_1Mn_{2.6}$	60	120	115	8	7
Example 7	$Mg_{97.3}Al_1Si_1Mn_{0.4}Ce_{0.3}$	60	125	135	10	5
Example 8	$Mg_{97.3}Al_1Si_1Mn_{0.4}Nd_{0.3}$	63	120	140	7	4

Example 9	$Mg_{97.1}Al_1Si_1Mn_{0.4}Y_{0.5}$	65	120	145	8	7
Example 10	$Mg_{96.6}Al_1Si_1Mn_{0.4}Zn_1$	66	120	130	7	14
Example 11	$Mg_{97.25}Al_1Si_1Mn_{0.4}Ce_{0.3}Be_{0.05}$	60	125	120	10	5
Example 12	$Mg_{96.8}Al_1Si_1Mn_{0.4}Ce_{0.3}Zr_{0.5}$	58	125	120	12	5
Example 13	$Mg_{98.8}Al_{0.2}Si_{0.5}Mn_{0.5}$	40	145	75	15	12
Example 14	$Mg_{97.595}Al_1Si_1Mn_{0.4}Ca_{0.005}$	60	105	120	7	11
Example 15	$Mg_{97.595}Al_1Si_1Mn_{0.4}Sn_{0.005}$	60	105	120	8	12
Example 16	$Mg_{97.3}Al_1Si_1Mn_{0.4}La_{0.3}$	60	110	130	8	9
Example 17	$Mg_{97.1}Al_1Si_1Mn_{0.4}Zn_{0.5}$	65	125	125	10	9
Example 18	$Mg_{96.95}Al_1Si_2Mn_{0.05}$	50	120	120	9	13
Example 19	$Mg_{96.6}Al_1Si_1Mn_{0.4}Ce_1$	80	100	165	1.2	15
Example 20	$Mg_{96.3}Al_1Si_1Mn_{0.4}Ce_{0.3}Zr_1$	65	100	130	8	12
Example 21	$Mg_{98.9}Al_{0.5}Si_{0.1}Mn_{0.5}$	50	140	95	15	8
Example 22	$Mg_{97.595}Al_1Si_1Mn_{0.4}Fe_{0.005}$	60	110	120	10	10
Example 23	$Mg_{97.595}Al_1Si_1Mn_{0.4}Ni_{0.005}$	55	115	115	12	11
Example 24	$Mg_{97.595}Al_1Si_1Mn_{0.4}Co_{0.005}$	60	115	115	10	12
Example 25	$Mg_{97.595}Al_1Si_1Mn_{0.4}Cu_{0.005}$	65	105	120	8	13
Comparative Example 1	$Mg_{94.6}Al_4Si_1Mn_{0.4}$	70	80	145	5	8
Comparative Example 2	$Mg_{97.1}Al_{1.5}Si_1Mn_{0.4}$	67	92	140	7	8
Comparative Example 3	$Mg_{96.1}Al_1Si_{2.5}Mn_{0.4}$	75	95	150	2	10
Comparative Example 4	$Mg_{96.1}Al_1Si_1Mn_{0.4}Zn_{1.5}$	78	90	160	3	20
Comparative	$Mg_{96.1}Al_1Si_1Mn_{0.4}Ce_{1.5}$	85	90	170	1.2	30

Example 5						
Comparative Example 6	$Mg_{96.1}Al_1Si_1Mn_{0.4}Zr_{1.5}$	75	90	135	2	8
Comparative Example 7	$Mg_{98.95}Al_{0.05}Si_{0.5}Mn_{0.5}$	30	145	60	15	16
Comparative Example 8	$Mg_{97.7}Al_{1.3}Si_1$	70	85	130	8	16
Comparative Example 9	$Mg_{97.59}Al_1Si_1Mn_{0.4}Ca_{0.01}$	60	95	120	7	20
Comparative Example 10	$Mg_{97.59}Al_1Si_1Mn_{0.4}Sn_{0.01}$	60	75	120	8	18
Comparative Example 11	$Mg_{94.5}Al_1Si_1Mn_{3.5}$	65	80	125	10	6

It can be seen from Table 1 that, the magnesium alloy of the present disclosure has a good comprehensive mechanical property, not only a relatively high strength and hardness, but also a relatively high ductility. It's more important that, the magnesium alloy of the present disclosure has a good heat conductivity coefficient, such as 100W/(m•K), even 120 W/(m•K) or more. Meanwhile, the magnesium alloy of the present disclosure has a good corrosion property.

It can be seen from comparing Example 4 with Comparative Examples 1-2 that if the content of Al in the magnesium alloy was too high, the heat conductivity property will get worse that the heat conductivity coefficient may be less than 100 W/(m•K), which may fail to meet the requirement as a structure part of an electric product.

It can be seen from comparing Example 6 with Comparative Example 11 that if the content of Mn in the magnesium alloy was too high, the heat conducting property of the magnesium alloy will decrease obviously.

It can be seen from comparing Example 5 with Comparative Example 3 that if the content of Si in the magnesium alloy was too high, the heat conducting property of the magnesium alloy will decrease and the ductility will obviously decreased that would be hard to produce thin-type products,

and the corrosion resistance of the magnesium alloy will obviously decreased thus limiting the application of the magnesium alloy.

It can be seen from comparing Examples 2, 10 and 17 with Comparative Example 4 that an appropriate content of Zn in the magnesium alloy may improve the strength of the magnesium alloy and have no obvious influence on the heat conducting property. But if the content of Zn in the magnesium alloy was too high, the conducting property of the magnesium alloy may be negatively affected and the ductility of the magnesium alloy may be decreased, thus that the magnesium alloy may be hard to produce thin-type products, meanwhile, the corrosion resistance of the magnesium alloy may get worse, thus limiting the application of the magnesium alloy.

It can be seen from comparing Examples 2, 7-9 and 16 with Comparative Example 4 that an appropriate content of rare earth elements may further improve the strength of the magnesium alloy. And, when the rare earth elements include Ce, Y and Nd, an appropriate content of rare earth elements may have no obvious influence on the heat conducting property of the magnesium alloy. In addition, when the rare earth elements include Ce and Nd, the corrosion resistance of the magnesium alloy may be improved. But it can be seen from comparing Examples 7 and 19 with Comparative Example 5 that if the content of the rare earth elements of the magnesium alloy was too high, the corrosion resistance of the magnesium alloy will get worse, the ductility of the magnesium alloy may be decreased, meanwhile, the heat conducting property of the magnesium alloy may be decreased, that the heat conducting coefficient may be less than 100 W/(m•K) , which may fail to meet the requirement as a structure part of an electric product.

It can be seen from comparing Example 7 with Examples 11-12 that an appropriate content of Be and Zr may further improve the corrosion resistance of the magnesium alloy. While, it can be seen from comparing Example 12 with Comparative Example 6 that if the content of Zr of the magnesium alloy was too high, the ductility of the magnesium alloy may be decreased, thus the magnesium alloy may be hard to produce thin-type products.

It can be seen from comparing Examples 2, 14 and 15 with Comparative Examples 9-10 that Ca and Sn may have negative influence on the heat conducting property and the corrosion resistance of the magnesium alloy, especially if the content of Ca and Sn was too large, the heat conducting property and the corrosion resistance of the magnesium alloy may be obviously poor,

thus limiting the use of the magnesium alloy.

It can be seen from comparing Example 2 with Examples 22-25 that, Fe, Ni, Co and Cu may have negative influence on the corrosion resistance and heat conducting property of the magnesium alloy, thus the content of the above elements in the magnesium alloy should not be too large.

Reference throughout this specification to "an embodiment," "some embodiments," "one embodiment", "another example," "an example," "a specific example," or "some examples," means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. Thus, the appearances of the phrases such as "in some embodiments," "in one embodiment", "in an embodiment", "in another example," "in an example," "in a specific example," or "in some examples," in various places throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples.

Although explanatory embodiments have been shown and described, it would be appreciated by those skilled in the art that the above embodiments cannot be construed to limit the present disclosure, and changes, alternatives, and modifications can be made in the embodiments without departing from spirit, principles and scope of the present disclosure.

WHAT IS CLAIMED IS:

1. A magnesium alloy, based on a total weight of the magnesium alloy, comprising:

about 0.2-1.35wt% of Al;

about 0.05-3wt% of Mn;

about 0.1-2wt% of Si;

about 0-0.005wt% of Fe;

about 0-0.01wt% of Cu;

about 0-0.01wt% of Ni;

about 0-0.01wt% of Co;

about 0-1wt% of a rare earth element;

about 0-1wt% of Zn;

about 0-0.1wt% of Be;

about 0-1wt% of Zr;

about 0-0.005wt% of Ca;

about 0-0.005wt% of Sn; and

about 90.505-99.65wt% of Mg.

2. A magnesium alloy, based on a total weight of the magnesium alloy, comprising:

about 0.2-1.35wt% of Al;

about 0.05-3wt% of Mn;

about 0.1-2wt% of Si;

about 0-0.005wt% of Fe;

about 0-0.01wt% of Cu;

about 0-0.01wt% of Ni;

about 0-0.01wt% of Co;

about 0-1wt% of a rare earth element;

about 0-1wt% of Zn;

about 0-0.1wt% of Be;

about 0-1wt% of Zr;

about 0-0.005wt% of Ca;

about 0-0.005wt% of Sn; and

a balance of Mg.

3. The magnesium alloy of claim 1 or 2, wherein based on the total weight of the magnesium alloy, the content of Al in the aluminum alloy ranges from about 0.5wt% to about 1wt%.

4. The magnesium alloy of any of claims 1-3, wherein based on the total weight of the magnesium alloy, the content of Si in the aluminum alloy ranges from about 1wt% to about 2wt%.

5. The magnesium alloy of any of claims 1-4, wherein based on the total weight of the magnesium alloy, the content of Mn in the aluminum alloy ranges from about 0.4wt% to about 2.6wt%.

6. The magnesium alloy of any of claims 1-5, wherein based on the total weight of the magnesium alloy, the content of the rare earth element in the aluminum alloy ranges from about 0.2wt% to about 0.5wt%.

7. The magnesium alloy of any of claims 1-6, wherein the rare earth element comprises at least one selected from a group consisted of Ce, Y and Nd.

8. The magnesium alloy of any of claims 1-7, wherein based on the total weight of the magnesium alloy, the magnesium alloy comprises at least one of:

about 0.1-0.5wt% of Zn;

about 0.01-0.05wt% of Be; and

about 0.1-0.5wt% of Zr.

9. A method of preparing a magnesium alloy, comprising:

smelting and cooling a raw material of the magnesium alloy, wherein

the raw material has a composition of the magnesium alloy capable of forming a magnesium alloy according to any one of claims 1-8.

10. Use of the magnesium alloy according to any one of claims 1-8 as a heat conducting material.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/082552

A. CLASSIFICATION OF SUBJECT MATTER

C22C 23/00(2006.01)i; C22C 23/02(2006.01)i; C22C 23/04(2006.01)i; C22C 23/06(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C22C 23

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNKI, CPRS, WPI, EPODOC: Al, aluminium, aluminum,Mn, manganese,Si, silicon

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 101130841 A (MENG Z ET AL) 27 February 2008 (2008-02-27) claims 1-4	1-10
X	US 944006 H (DOW CHEM CO) 02 March 1976 (1976-03-02) abstract	1-10
X	CN 101269386 A (MITG) 24 September 2008 (2008-09-24) claims 1-16	1-10
X	JP 3879038 B2 (ZH SHINSANGYO SOZO KENKYU KIKO) 07 February 2007 (2007-02-07) abstract	1-10

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 September 2015	**30 September 2015**

Name and mailing address of the ISA/CN	Authorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2015/082552

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	101130841	A	27 February 2008	CN	101130841	B	25 August 2010
US	944006	H	02 March 1976		None		
CN	101269386	A	24 September 2008	KR	20080085662	A	24 September 2008
				CN	101804553	B	02 January 2013
				CN	101804553	A	18 August 2010
				JP	2008229650	A	02 October 2008
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				CN	101269386	B	21 April 2010
JP	3879038	B2	07 February 2007	JP	2003193259	A	09 July 2003