Abstract:

Title: ALUMINUM ALLOY AND METHOD OF PREPARING THE SAME

An aluminum alloy contains 3-7wt % of Si, 5-10wt % of Zn, 1-5wt % of Cu, 1-3wt % of Mg, 0-0.3wt % of a rare earth element, 0-1wt % of an additional element, and 73.7-90wt % of Al. The additional element is at least one selected from a group consisting of Ti, Zr, Mn, Fe, Cd, Cr, B, Bi, Ni and Sr. A method of preparing the aluminum alloy is also provided.
ALUMINUM ALLOY AND METHOD OF PREPARING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and benefits of Chinese Patent Application No. 201410192835.1, filed with the State Intellectual Property Office of P. R. China on May 8, 2014, the entire content of which is incorporated herein by reference.

FIELD

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

BACKGROUND

As main structure materials in national economy, aluminum alloys have a lot of advantages such as small density, high strength, being easy to be molded and processed, good electrical conductivity and thermal conductivity, and being rich in resource, and are used widely in many fields, such as aviation, spaceflight, traffic, building, petroleum, chemical engineering, electronics, electric power, and national defense.

With a rapid economic development of economic construction, especially industries such as automobile, electronics and machinery, higher and higher requirements are made on material performances and casting performances of the aluminum alloy. Especially, in consumer electronics industry, as electronics become lighter and smaller, it is required that materials have not only good casting performances but also good alloy strength.

At present, aluminum alloys formed by die casting are mainly of the Al-Si-Cu series, such as those with Nos. YL102, YL104, YL1 12, YL1 17, ADC12 and A380. Although these alloys have good casting performances, their poor mechanical properties, especially yield strength and breaking strength, can hardly meet the requirements of the present market. It is necessary to produce an aluminum alloy with a good casting performance and a good mechanical property.

Chinese patent application publication No. 102776426A discloses an aluminum alloy
with high purity, high strength and high tenacity. Based on the total weight of the aluminum alloy, the aluminum alloy comprises following components: 5-8.5wt% of Zn, 1.5-2.8wt% of Mg, 1.2-2.5wt% of Cu, 0.5-1.5wt% of Mn, 0.1-0.2wt% of Cd, 0.05-0.25wt% of Sr, 0.01-0.15wt% of Bi, 0.005-0.05wt% of Ti, Fe having a content smaller than 0.12wt%, Si having a content smaller than 0.1wt%, and a balance of Al.

Chinese patent application publication No. 100410406C discloses an aluminum alloy with high purity, high strength and high tenacity. Based on the total weight of the aluminum alloy, the aluminum alloy comprises the following components: 4.5-7.0wt% of Cu, 0.05-0.3wt% of V, 0.3-0.45wt% of Mn, 0.15-0.35wt% of Ti, 0.005-0.06wt% of B, 0.15-0.25wt% of Cd, 0.05-0.2wt% of Zr, 0.03-0.7wt% of Pr, and a balance of Al.

Chinese patent application publication No. 1204281C discloses an aluminum alloy for structure parts for aviation with high purity and a high strength. Based on the total weight of the aluminum alloy, the aluminum alloy comprises the following components: 7-9wt% of Zn, 1.7-3.0wt% of Mg, 1.5-2.6wt% of Cu, 0.1-0.25wt% of Zr, Cr having a content smaller than 0.1wt%, Ti having a content smaller than 0.06wt%, Fe having a content smaller than 0.15wt%, Si having a content smaller than 0.12wt%, and a balance of Al.

Although the above aluminum alloys have improved performances, the casting performance thereof, especially fluidity, is still unsatisfactory, which makes it hard to produce a product with thin-wall.

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 poor alloy strength and casting performances. Accordingly, the present disclosure aims to provide an aluminum alloy with not only strong strength but also excellent casting performances.

According to a first aspect of the present disclosure, there is provided an aluminum alloy, comprising: based on the total weight of the aluminum alloy, 3-7wt% of Si; 5-10wt% of Zn; 1-5wt% of Cu; 1-3wt% of Mg; 0-0.3wt% of a rare earth element; 0-1wt% of an additional element, the additional element being at least one selected from a group consisted of Ti, Zr, Mn, Fe, Cd, Cr, B, Bi, Ni and Sr; and 73.7-90wt% of Al.
According to a second aspect of the present disclosure, there is provided an aluminum alloy, comprising: based on the total weight of the aluminum alloy, 3-7wt% of Si; 5-10wt% of Zn; 1-5wt% of Cu; 1-3wt% of Mg; 0-0.3wt% of a rare earth element; 0-lwt% of an additional element, the additional element being at least one selected from a group consisted of Ti, Zr, Mn, Fe, Cd, Cr, B, Bi, Ni and Sr; and a balance of Al.

According to a third aspect of the present disclosure, there is provided a method of preparing an aluminum alloy, comprising the steps: smelting and cooling a raw material of the aluminum alloy, the composition of the raw material capable of forming the above-mentioned aluminum alloy according to embodiments of the present disclosure.

According to embodiments of the present disclosure, the aluminum alloy has excellent casting performances. During casting, cracks may not or hardly occur in the aluminum alloy. In addition, the obtained casting product may have not only high strength but also excellent tenacity, and is suitable for producing thin-walled 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 an aluminum alloy. Based on the total weight of the aluminum alloy, the aluminum alloy contains 3-7wt% of Si, 5-10wt% of Zn, 1-5wt% of Cu, 1-3wt% of Mg, 0-0.3wt% of a rare earth element, 0-lwt% of an additional element, and 73.7-90wt% of Al. The additional element is at least one selected from a group consisted of Ti, Zr, Mn, Fe, Cd, Cr, B, Bi, Ni and Sr.

In some embodiments of the present disclosure, based on the total weight of the aluminum alloy, the content of Si in the aluminum alloy ranges from 3wt% to 6wt%, for example, 4wt% to 6wt%.

In some embodiments of the present disclosure, based on the total weight of the aluminum
alloy, the content of Zn in the aluminum alloy ranges from 5.5wt% to 8wt%.

In some embodiments of the present disclosure, based on the total weight of the aluminum alloy, the content of Cu in the aluminum alloy ranges from 1wt% to 2.5wt%.

In some embodiments of the present disclosure, based on the total weight of the aluminum alloy, the content of Mg in the aluminum alloy ranges from 1wt% to 2wt%.

In some embodiments of the present disclosure, based on the total weight of the aluminum alloy, the content of the rare earth element in the aluminum alloy ranges from 0.01wt% to 0.2wt%, alternatively 0.01wt% to 0.1wt%. With this content, both the tenacity and flowability of the aluminum alloy may be improved.

In some embodiments of the present disclosure, the rare earth element comprises La and/or Ce.

In some embodiments of the present disclosure, the additional element comprises at least one selected from a group consisted of Ti, Zr, B, Bi, and Ni. In some embodiments of the present disclosure, based on the total weight of the aluminum alloy, the content of the addition element (i.e. those selected from at least one of a group consisted of Ti, Zr, B, Bi, and Ni) ranges from 0.01wt% to 0.5wt%, such as 0.01wt% to 0.3wt%. With this additional element and the content thereof, the tenacity of the aluminum alloy may be further improved.

In some embodiments of the present disclosure, the additional element comprises at least one selected from a group consisted of Fe, Mn, Cd and Cr. In some embodiments of the present disclosure, based on the total weight of the aluminum alloy, the content of the addition element (i.e. those selected from at least one of a group consisted of Fe, Mn, Cd and Cr) ranges from 0.01wt% to 1wt%, such as 0.02wt% to 0.2wt%. With this additional element and the content thereof, the strength of the aluminum alloy may be further improved.

In some embodiments, the additional element comprises Sr. Based on the total weight of the aluminum alloy, the content of Sr in the aluminum alloy ranges from 0.05wt% to 0.1wt%. With Sr as the additional element and the content thereof, the corrosion resistance of the aluminum alloy may be further improved.

In some embodiments of the present disclosure, a small quantity of other metal elements may be present in the aluminum alloy, such as at least one selected from a group consisted of Li, Na, K, Be, Ca, Ba, Ga, In, Ge, Sn, Sb, Sc, Y, V, Nb, Mo, W, Tc, Ru, Co, Pd, Pt, Ag and Au. Based
on the total weight of the aluminum alloy the total weight of the above metal elements is less than 1wt%, alternatively less than 0.5wt%, such as less than 0.2wt%. The above metal elements may be from unavoidable impurities of the raw material of the aluminum alloy, or alternatively from raw materials added for preparing the aluminum alloy as one component of the aluminum alloy.

In some embodiments of the present disclosure, the content of Al element in the aluminum alloy may be adjusted according to practical requirements, such as amounts of other components of the aluminum alloy.

In an embodiment of the present disclosure, based on the total weight of aluminum alloy, the aluminum alloy comprises: 3-7wt% of Si, 5-10wt% of Zn, 1-5wt% of Cu, 1-3wt% of Mg, 0-0.3wt% of a rare earth elements, 0-1wt% of an additional elements, and a balance of Al. The additional element comprises at least one selected from a group consisted of Ti, Zr, Mn, Fe, Cd, Cr, B, Bi, Ni, and Sr.

In some embodiments of the present disclosure, the aluminum alloy may contain other metal elements described above. Alternatively, the aluminum alloy may not contain any other metal elements.

The aluminum alloy according to embodiments of the present disclosure may be prepared by a conventional smelting casting process for aluminum alloys. Generally, a raw material of the aluminum alloy may be smelted and cooled to form the aluminum alloy. The obtained aluminum alloy may be casted to form a molded body with various different shapes.

In some embodiments, the method for preparing the aluminum alloy of the present disclosure includes following steps.

In step SI, a raw material of the aluminum alloy and a fluxing agent are provided.

The raw material was provided according to the composition of the aluminum alloy, such as the components and elements listed in embodiments described above. Each element in the aluminum alloy may be provided in a form of pure metal or intermediate alloy. Generally, Al and Mg may be provided in a form of pure metal respectively, while Si and Cu may be provided in a form of Si-Al intermediate alloy and Cu-Al intermediate alloy respectively.

The fluxing agent may include a covering agent, a refining agent and a modificator, whose types and contents may be conventional options in the art.
In some embodiments, the covering agent may be LFG-J00. Based on 100 weight parts of the raw material, the amount of the covering agent may be 0.01 to 0.2 weight parts. With the covering agent and the amount, the oxidation, burn and gas suction of melts may be prevented.

In some embodiments, the refining agent may be JL-J301. Based on 100 weight parts of the raw material, the amount of the refining agent may be 0.01 to 0.2 weight parts. With the refining agent and the amount, both gases and inclusions may be removed.

In some embodiments, the modifier may be LBZ-J0K. Based on 100 weight parts of the raw material of the aluminum alloy, the amount of the modifier may be 0.01 to 0.1 weight parts. With the modifier and the amount, a plurality of synthetic non-spontaneous crystal nucleus may be formed, and thus fine casting grains may be formed.

In step S2, the raw material is melted by heating.

In an embodiment, Mg in the aluminum alloy is provided in a form of pure metal (i.e., magnesium ingot), other elements in the raw material are melted to form an alloy liquid, and the magnesium ingot is added into the alloy liquid and pressed to a lower part of the alloy liquid. In this way, the magnesium ingot melts completely without being damaged from burning.

In some embodiments, a final temperature of the alloy liquid is controlled at a range of 750°C to 770°C.

In step S3, the alloy liquid is refined by adding the refining agent in the alloy liquid. With step S3, the alloy liquid may be refined, by which nonmetallic inclusions in the alloy liquid, such as inclusions and gases, may be removed. In some embodiments, the refining may be performed at a temperature of 700°C to 720°C for about 5-30 min. In some embodiments, step S3 further includes maintaining the alloy liquid at this temperature for 5 to 15 min.

In step S4, the refined alloy liquid is casted in a mould. In some embodiments, step S4 further includes cooling the casted product to obtain an alloy ingot.

In step S5, the alloy ingot is subjected to a die casting process. In some embodiments, during the die casting process, a casting temperature of about 680°C to 780°C; a temperature of the mould is about 100°C to 300°C; and a temperature of the charging barrel is 30°C to 200°C.

In some embodiments, the method further includes subjecting the aluminum alloy obtained from step S5 to an aging treatment at an environment temperature for 10-30 days.

According to some embodiments of the present disclosure, the aluminum alloy has both a
high fluidity and a good casting performance. The aluminum alloy may not be prone to break in
the process of casting, i.e. cracks hardly generate in the aluminum alloy during the casting
process. In addition, a casting product obtained from the aluminum alloy may have both a good
strength and a good tenacity, and is suitable for manufacturing thin-walled 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, all samples are prepared according
to ISO 6892-1, and the tensile strength of each sample is tested with a universal testing machine.

In the following Examples and Comparative Examples, the hardness of each sample is tested
according to GB/T 4340. 1-2009 with a load of 3kgf.

In the following Examples and Comparative Examples, the fluidity of each sample is tested
with a single-screw fluidity testing mould, with a cross section of 5.5mmx3mm, a casting volume
of 30 cm³, an injection speed of 0.8mm/s, and a casting temperature of 750°C.

Example 1

In this example, an aluminum alloy E1 was prepared.

1) Raw materials of the aluminum alloy were provided according to a composition formula
Al₈i₅Si₆Zn₅Cu₂₅Mg₂, in which numbers indicated weight percentages of corresponding elements
based on the total weight of the aluminum alloy. Al was provided in the form of aluminum ingot
(having a purity>99.9wt%), Mg was provided in the form of magnesium ingot (having a purity>99.9wt%), Zn was provided in the form of zinc ingot (having a purity>99.9wt%), Si was
provided in the form of Al-Si alloy, and Cu was provided in the form of Al-Cu alloy.

A fluxing agent was provided by mixing covering agent LFG-J00, refining agent JL-J301,
and modifier LBZ-J0K. Based on 100 weight parts of the raw material, the amount of the
covering agent was 0.01 weight parts, the amount of refining agent was 0.01 weight parts, and the
amount of modifier was 0.01 weight parts.

2) The raw materials were dried, in which, aluminum ingot, magnesium ingot and zinc ingot
were dried at a temperature of 100°C ± 10°C, Al-Si alloy and Al-Cu alloy were dried at a
temperature of 150°C ± 10°C.
3) First, an inner surface of a crucible was coated with a coating material, and the crucible was heated to a temperature at a range of 200°C to 250°C. The above aluminum ingot, zinc ingot, Al-Si alloy and Al-Cu alloy were placed in the crucible, covered with the covering agent, and heated. After the raw materials were completely melted, the crucible was kept for 10min. The melted raw material liquid was heated to 750°C, then the above magnesium ingot was added into the melted raw material liquid, and pressed below the metal liquid level. The heating was continued. After all components were melted completely, the resulted alloy liquid was stirred uniformly, and maintained at a temperature of 750°C to 770°C.

4) The temperature of the alloy liquid was decreased to a range of 700°C to 720°C, and hexachloroethane (refining agent) was pressed below the liquid level of the alloy liquid with a bell jar, and then the alloy liquid was refined for about 10min.

The bell jar was taken out, and residual oxides on the bell jar were washed. Then inclusions on the surface of the alloy liquid were removed with a fluxing spoon.

5) The alloy liquid was kept at the present temperature for 10min after removing the inclusions, then cooled to obtain an alloy ingot.

6) The obtained alloy ingot was subjected to die casting under a casting temperature of 750°C, a mould temperature of 200°C, and a charging barrel temperature of 150°C. The obtained casting product was then subjected to an aging treatment naturally under an environment temperature for 15 days to obtain the aluminum alloy. The results of tensile property, hardness and fluidity of the aluminum alloy E1 were recorded in Table 1.

Example 2

In this example, an aluminum alloy E2 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al83.5Si4Zn8Cu2.5Mg2. The results of tensile property, hardness and fluidity of the aluminum alloy E2 were recorded in Table 1.

Example 3

In this example, an aluminum alloy E3 was prepared by a method which is substantially the
same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al84.5Si3Zn8Cu2.5Mg2. The results of tensile property, hardness and fluidity of the aluminum alloy E3 were recorded in Table 1.

Example 4

In this example, an aluminum alloy E4 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al84.5Si4Zn8Cu2.5Mg1. The results of tensile property, hardness and fluidity of the aluminum alloy E4 were recorded in Table 1.

Example 5

In this example, an aluminum alloy E5 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al83.48Si4Zn8Cu2.5Mg2La0.02. The results of tensile property, hardness and fluidity of the aluminum alloy E5 were recorded in Table 1.

Example 6

In this example, an aluminum alloy E6 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al83.47Si4Zn8Cu2.5Mg2Ce0.03. The results of tensile property, hardness and fluidity of the aluminum alloy E6 were recorded in Table 1.

Example 7

In this example, an aluminum alloy E7 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula
Al_{83.2}Si_{4}Zn_{8}Cu_{2.5}Mg_{2}Ti_{0.2}Ce_{0.2}. The results of tensile property, hardness and fluidity of the aluminum alloy E7 were recorded in Table 1.

Example 8

In this example, an aluminum alloy E8 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al_{83.2}Si_{4}Zn_{8}Cu_{2.5}Mg_{2}Ti_{0.2}Ce_{0.2}. The results of tensile property, hardness and fluidity of the aluminum alloy E8 were recorded in Table 1.

Example 9

In this example, an aluminum alloy E9 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al_{82.8}Si_{4}Zn_{8}Cu_{2.5}Mg_{2}Ti_{0.2}Fe_{0.2}Bo_{i}Si_{0.2}Ce_{0.2}. The results of tensile property, hardness and fluidity of the aluminum alloy E9 were recorded in Table 1.

Example 10

In this example, an aluminum alloy E10 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al_{6}Si_{4}Zn_{5.5}Cu_{2.5}Mg_{2}. The results of tensile property, hardness and fluidity of the aluminum alloy E10 were recorded in Table 1.

Example 11

In this example, an aluminum alloy E11 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al_{6}Si_{4}Zn_{8}Cu_{i}Mg_{i}. The results of tensile property, hardness and fluidity of the aluminum alloy E11 were recorded in Table 1.
Example 12

In this example, an aluminum alloy E12 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al85.8Si4Zn5.5Cu2.5Mg2Mn0.1Bi0.01. The results of tensile property, hardness and fluidity of the aluminum alloy E12 were recorded in Table 1.

Example 13

In this example, an aluminum alloy E13 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al85.97Si4Zn5.5Cu2.5Mg2Cd0.1Ni0.1Cr0.1. The results of tensile property, hardness and fluidity of the aluminum alloy E13 were recorded in Table 1.

Comparative example 1

In this comparative example, an aluminum alloy CE1 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al87.5Si4Zn8Cu2.5Mg2. The results of tensile property, hardness and fluidity of the aluminum alloy CE1 were recorded in Table 1.

Comparative example 2

In this comparative example, an aluminum alloy CE2 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula Al86Si1.5Zn8Cu2.5Mg2. The results of tensile property, hardness and fluidity of the aluminum alloy CE2 were recorded in Table 1.

Comparative example 3
In this comparative example, an aluminum alloy CE3 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula \(\text{Al}_{78.5}\text{Si}_{9}\text{Zn}_{9}\text{Cu}_{2.5}\text{Mg}_{2}\). The results of tensile property, hardness and fluidity of the aluminum alloy CE3 were recorded in Table 1.

Comparative example 4

In this comparative example, an aluminum alloy CE4 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula \(\text{Al}_{81.5}\text{Si}_{4}\text{Zn}_{9}\text{Cu}_{2.5}\text{Mg}_{2}\). The results of tensile property, hardness and fluidity of the aluminum alloy CE4 were recorded in Table 1.

Comparative example 5

In this comparative example, an aluminum alloy CE5 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula \(\text{Al}_{89.5}\text{Si}_{4}\text{Zn}_{9}\text{Cu}_{2.5}\text{Mg}_{2}\). The results of tensile property, hardness and fluidity of the aluminum alloy CE5 were recorded in Table 1.

Comparative example 6

In this comparative example, an aluminum alloy CE6 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.

Raw materials of the aluminum alloy were provided according to a formula \(\text{Al}_{84.8}\text{Si}_{4}\text{Zn}_{9}\text{Cu}_{2.5}\text{Mg}_{0.7}\). The results of tensile property, hardness and fluidity of the aluminum alloy CE6 were recorded in Table 1.

Comparative example 7

In this comparative example, an aluminum alloy CE7 was prepared by a method which is substantially the same as the method in Example 1, with the following exceptions.
Raw materials of the aluminum alloy were provided according to a formula Al86.5Si4Zn8Cu0.5Mg1. The results of tensile property, hardness and fluidity of the aluminum alloy CE7 were recorded in Table 1.

If the aluminum alloy contains no Si or a small quantity of Si, as shown in Comparative example 1 and Comparative example 2, although the aluminum alloy may have a relative high fracture elongation, the aluminum alloy may have a poor fluidity. In this condition, the aluminum alloy may generate cracks easily in the process of casting, thus resulting that a final product prepared by the aluminum alloy may have a poor strength.

If the content of Si in the aluminum alloy is too high, as shown in Comparative example 3, the aluminum alloy may have a relative good fluidity and a relative high strength, however, a tenacity of the aluminum alloy was relatively poor. In this condition, the aluminum alloy may generate cracks easily in the process of casting, and be unsuitable to use as a structure part.

If the content of Mg in the aluminum alloy is too high, as shown in Comparative example 4, the aluminum alloy has a relative low fracture elongation, which may generate cracks easily in the process of casting.

If the content of Zn in the aluminum alloy is too small, as shown in Comparative example 5, the aluminum alloy has a relative low strength and a relative low hardness, which may hardly meet use requirements of structure part.

If the content of Mg in the aluminum alloy is too small, as shown in Comparative example 6, the aluminum alloy has a relative low hardness, which may hardly meet the requirements of structure part.

If the content of Cu is too small, as shown in Comparative example 7, the aluminum alloy has a relative low hardness, which may hardly meet the requirement of being used as a structure part.

The aluminum alloy according to embodiments of the present disclosure not only has a high strength, a good tenacity, but also has a good fluidity, which may be prone to cast. In addition, a cast product of the aluminum alloy hardly crack, has a high mould yield, and is suitable for producing thin-walled products.
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<th>Table 1</th>
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<tr>
<td><strong>Composition formula</strong>*</td>
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*Numbers in composition formula represent weight percentages of corresponding elements in the aluminum alloy.

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. An aluminum alloy, comprising: based on the total weight of the aluminum alloy,
   3-7wt% of Si;
   5-10wt% of Zn;
   1-5wt% of Cu;
   1-3wt% of Mg;
   0-0.3wt% of a rare earth element;
   0-1wt% of an additional element, the additional element being at least one selected from
   a group consisted of Ti, Zr, Mn, Fe, Cd, Cr, B, Bi, Ni and Sr; and
   73.7-90wt% of Al.
2. An aluminum alloy, comprising: based on the total weight of the aluminum alloy,
   3-7wt% of Si;
   5-10wt% of Zn;
   1-5wt% of Cu;
   1-3wt% of Mg;
   0-0.3wt% of a rare earth element;
   0-1wt% of an additional element, the additional element being at least one selected from
   a group consisted of Ti, Zr, Mn, Fe, Cd, Cr, B, Bi, Ni and Sr; and
   a balance of Al.
3. The aluminum alloy of claim 1 or 2, wherein based on the total weight of the aluminum
   alloy, the content of Si in the aluminum alloy ranges from 3wt% to 6wt%.
4. The aluminum alloy of any of claims 1-3, wherein based on the total weight of the
   aluminum alloy, the content of Zn in the aluminum alloy ranges from 5.5wt% to 8wt%.
5. The aluminum alloy of any of claims 1-4, wherein based on the total weight of the
   aluminum alloy, the content of Cu in the aluminum alloy ranges from 1wt% to 2.5wt%.
6. The aluminum alloy of any of claims 1-5, wherein based on the total weight of the
   aluminum alloy, the content of the rare earth element in the aluminum alloy ranges from
   0.01wt% to 0.1wt%.
7. The aluminum alloy of claim 1 or 6, wherein the rare earth element comprises La and/or
8. The aluminum alloy of any of claims 1-7, wherein the additional element comprises at least one selected from a group consisted of Ti, Zr, B, Bi, and Ni.

9. The aluminum alloy of claim 8, wherein based on the total weight of the aluminum alloy, the content of the additional element in the aluminum alloy ranges from 0.01wt% to 0.5wt%.

10. The aluminum alloy of any of claims 1-8, wherein the additional element comprises at least one selected from a group consisted of Fe, Mn, Cd and Cr.

11. The aluminum alloy of claim 10, wherein based on the total weight of the aluminum alloy, the content of the additional element in the aluminum alloy ranges from 0.01wt% to 1wt%.

12. The aluminum alloy of any of claims 1-11, wherein the additional element comprises Sr, and based on the total weight of the aluminum alloy, the content of Sr in the aluminum alloy ranges from 0.05wt% to 0.1wt%.

13. A method of preparing an aluminum alloy, comprising: smelting and cooling a raw material of the aluminum alloy, the composition of the raw material capable of forming an aluminum alloy according to any one of claims 1-12.

14. The method of claim 13, further comprising casting the aluminum alloy.
INTERNATIONAL SEARCH REPORT

International application No. PCT/CN2015/077756

A. CLASSIFICATION OF SUBJECT MATTER
   C22C 21/10(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)
   C22C21
   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)
   CNABS, CNKI, WPI, EPDOC: Al, aluminium, aluminum, Si, silicon, Zn, zinc, Cu, copper, Mg, magnesium, RE, REM, rare earth

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Category</th>
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<th>Relevant to claim No.</th>
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<td>US 4284429 A (SAVAS JOHN) 18 August 1981 (1981-08-18) claims 1 and 4</td>
<td>1-14</td>
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<tr>
<td>A</td>
<td>CN 101760679 A (NORTHEAST LIGHT ALLOY CO LTD) 30 June 2010 (2010-06-30) the whole document</td>
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Further documents are listed in the continuation of Box C. [✓] See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search 18 July 2015
Date of mailing of the international search report 31 July 2015

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