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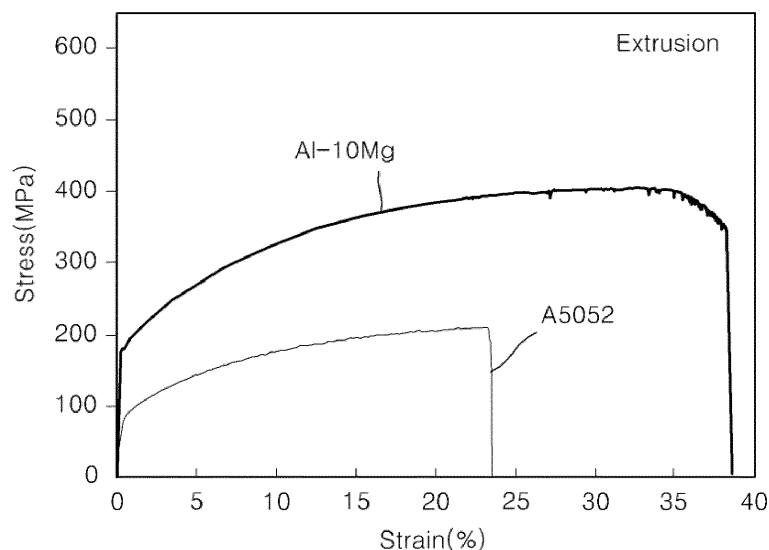
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(54) **ALUMINUM-MAGNESIUM ALLOY AND MANUFACTURING METHOD THEREOF**

(57) Provided are an extruded aluminum (Al)-magnesium (Mg) material and a method of producing the same. An Al-Mg master alloy having a first Mg content is provided. An Al-Mg alloy having a second Mg content

less than the first Mg content is prepared by adding the Al-Mg master alloy into molten Al and then casting the molten Al. An extruded Al-Mg material is prepared by extruding the Al-Mg alloy.

FIG. 6



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Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to a technology of producing an aluminum (Al) alloy, and more particularly, to an Al-magnesium (Mg) alloy prepared by adding Mg as an alloying element, and a method of producing the same.

BACKGROUND ART

10 **[0002]** Currently, magnesium (Mg) is regarded as one of main alloying elements in an aluminum (Al) alloy. Addition of Mg allows an Al alloy to have a high strength, to be favorable to surface treatment, and to have improved corrosion resistance. As shown in FIG. 1, Mg may be soluble in Al to about 17.4 weight percent (wt%) at about 450°C.

[0003] However, due to Mg having a chemically high oxidizing potential, an oxide or another inclusion may be mixed into molten Al during Mg is alloyed into the molten Al and thus the quality of molten metal may deteriorate. If the amount of Mg added into molten Al is added, a problem due to oxidation of Mg becomes serious. The deterioration in quality of molten metal may greatly influence properties of an alloy obtained by casting the molten metal.

[0004] For example, if molten Al having a poor quality die to a high content of Mg is casted, casting cracks may be generated. Also, an Al-Mg alloy prepared by casting the above molten Al has a greatly reduced processability. For example, if the content of Mg in the Al-Mg alloy is equal to or greater than 8.5wt%, industrially, processing is disabled.

20 **[0005]** Accordingly, when an Al- Mg alloy is prepared, in consideration of castability and processability, in general, the content of Mg is designed not to exceed 5wt%. In order to prevent an oxide or another inclusion from being mixed due to addition of Mg, the surface of molten metal may be coated with a protective gas such as an SF₆ gas when Mg is added. However, the SF₆ gas not only is high- priced to increase costs but also causes an environmental problem and thus is gradually restricted all over the world. Accordingly, preparation of an Al- Mg alloy capable of minimizing the use of an SF₆ gas and having a high the content of Mg is seriously required.

DETAILED DESCRIPTION OF THE INVENTION

TECHNICAL PROBLEM

30 **[0006]** The present invention provides an aluminum (Al)- magnesium (Mg) alloy capable of minimizing the use of a protective gas, having excellent mechanical properties and a high processability, and having a high the content of Mg, and a method of producing the same. However, the present invention is not limited thereto.

TECHNICAL SOLUTION

[0007] According to an aspect of the present invention, there is provided a method of producing an aluminum (Al)-magnesium (Mg) alloy. Mg is added into first molten Al. An Al- Mg master alloy having a first Mg content is prepared by casting the first molten Al in which Mg is added. The Al- Mg master alloy is added into second molten Al. An Al- Mg alloy having a second Mg content less than the first Mg content is casted by casting the second molten Al.

[0008] A holding time for melting the Al-Mg master alloy in the adding of the Al-Mg master alloy may be less than the holding time for melting the Mg in the adding of the Mg.

[0009] A melting point of the Al-Mg master alloy may be less than the melting point of the Mg by 100 to 200°C.

[0010] The second Mg content may be 2 to 12wt%. Also, the first Mg content may be 5 to 40wt%.

45 **[0011]** An amount of a protective gas used to prevent ignition of the Mg in the adding of the Mg may be greater than the amount of the protective gas used in the adding of the Al-Mg master alloy. For example a protective gas may be used to prevent ignition of the Mg in the adding of the Mg, and the protective gas may not be used in the adding of the Al-Mg master alloy.

[0012] The method may further include extruding or rolling the Al-Mg alloy.

50 **[0013]** According to another aspect of the present invention, there is provided an aluminum (Al)- magnesium (Mg) alloy prepared by adding an Al- Mg master alloy having a first Mg content into molten Al and then casting the molten Al, so as to have a second Mg content less than the first Mg content.

[0014] The Al-Mg alloy has a higher tensile strength and an equivalent or higher elongation in comparison to a commercial Al-Mg alloy having a lower Mg content.

ADVANTAGEOUS EFFECTS

55 **[0015]** According to embodiments of the present invention, an aluminum (Al)- magnesium (Mg) alloy having a very

good castability may be produced by preparing an Al- Mg master alloy having a high content of Mg and then diluting the Al- Mg master alloy without using a protective gas or using a small amount of the protective gas.

[0016] The above-prepared Al-Mg alloy and a processed material (for example, an extruded material or a rolled material) thereof may have excellent mechanical properties (for example, a high strength and excellent elongation properties) in comparison to a conventional commercial Al alloy and a processed material thereof.

[0017] The effects of the present invention are not limited to the above-described effects and other effects not described above may be understood by one of ordinary skill in the art from the following detailed description of the invention.

DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a graph showing an aluminum (Al)- magnesium (Mg) state.

FIG. 2 is a flowchart of a method of producing an Al-Mg alloy, according to the present invention.

FIGS. 3A and 3B are images showing the surfaces of residual metal in cases when an SF₆ gas is not used and is used as a protective gas.

FIGS. 4A and 4B are images showing the states after an Al-Mg alloy prepared according to the present invention and a conventional Al-Mg alloy are extruded.

FIGS. 5A and FIG. 5B are an image and a graph showing a microstructure and a tensile test result of an Al-Mg alloy casted according to the present invention.

FIG. 6 is a graph comparatively showing mechanical properties of an Al-Mg alloy casted according to the present invention and a 5052 Al alloy after they are extruded.

FIG. 7 is an image showing a microstructure of an Al-Mg alloy casted according to the present invention after it is extruded.

FIG. 8 is a graph comparatively showing mechanical properties of an Al-Mg alloy casted according to the present invention and a 5052 Al alloy after they are rolled.

FIG. 9 is an image showing a microstructure of an Al-Mg alloy casted according to the present invention after it is rolled.

MODE OF THE INVENTION

[0019] Hereinafter, the present invention will be described in detail by explaining embodiments of the invention with reference to the attached drawings. The invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the concept of the invention to one of ordinary skill in the art. In the drawings, the thicknesses of layers and regions are exaggerated for convenience of explanation.

[0020] If a weight percent (wt%) range is greater or less than a certain value, it may not include the value and may be merely designated as a range. If the range is equal to or greater or less than a certain value, it may include the value.

[0021] FIG. 2 is a flowchart of a method of producing an aluminum (Al)- magnesium (Mg) alloy, according to embodiments of the present invention.

[0022] Initially, molten Al for producing an Al- Mg master alloy is provided (S1) . In this case, the molten Al provided to form an Al- Mg master alloy may be referred to as first molten Al. Meanwhile, molten Al provided to add the Al- Mg master alloy in the description below may be referred to as second molten Al in order to be distinguished from the first molten Al.

[0023] In this case, a master alloy refers to an alloy prepared to be added into molten metal provided in a subsequent process, and a resultant material prepared by adding the master alloy is referred to as an alloy in order to be distinguished from the master alloy. Accordingly, in the present invention, an alloy prepared by adding a prepared Al-Mg master alloy to molten Al is referred to as an Al-Mg alloy.

[0024] Then, Mg is added into the first molten Al and then is melted (S2) . In this case, in consideration of a ratio that the added Mg is to be diluted in the second molten Al, the content of the added Mg may be set to be higher than the content of Mg in a typical Al- Mg alloy.

[0025] When an Al-Mg master alloy is prepared, a top surface of the Mg-added first molten Al may be protected by using a protective gas. The protective gas may be SF₆, SO₂, CO₂, HFC-134A, Novec™612, an inert gas, an equivalent thereof, or a gas mixture thereof. If a high content of Mg is added into the molten Al, the protective gas may prevent an oxide or other impurities from being formed in the molten Al due to a phenomenon that Mg in the molten Al reacts with oxygen in the air and thus is ignited.

[0026] FIGS. 3A and 3B are images showing the surfaces of residual metal in cases when an SF₆ gas is not used and is used as a protective gas and 6wt% of Mg is added into the molten Al. Referring to FIG. 3A, when the SF₆ gas is not used, the residual metal turns black due to oxidation of Mg. On the other hand, referring to FIG. 3B, when the SF₆ gas

is used, the residual metal is hardly oxidized.

[0027] The Mg-added first molten Al may be stirred by using an appropriate means. For example, it may be mechanically stirred by using a stirring means provided under a furnace or may be stirred by using an electromagnetic stirring means provided outside the furnace.

[0028] After Mg is sufficiently melted, an Al-Mg master alloy is prepared by casting the first molten Al in a mold (S3). In this case, the mold may be one selected from a metallic mold, a ceramic mold, a graphite mold, and an equivalent thereof. Also, the casting method may include sand casting, die casting, gravity casting, continuous casting, low-pressure casting, squeeze casting, lost wax casting, thixo casting, or the like. However, the present invention does not limit the type of a mold and a method of casting.

[0029] The above-prepared Al-Mg master alloy is added into the second molten Al as a source of Mg.

[0030] In more detail, the second molten Al is prepared (S4) and the prepared Al-Mg master alloy is added (S5). In this case, a melting point of the Al-Mg master alloy is reduced in comparison to pure Mg as shown in the graph of FIG. 1.

[0031] For example, if the content of Mg in the Al-Mg master alloy is about 38wt%, the melting point of the Al-Mg master alloy is reduced in comparison to the melting point of pure Mg (651 °C) by about 200°C. The melting point of the Al-Mg master alloy may be determined according to the content of Mg and may be lower than the melting point of pure Mg by about 100 to 200°C in consideration of a melting time. The content of Mg in the Al-Mg master alloy may be appropriately adjusted and thus the above-mentioned range of reduction in melting point may be appropriately selected.

[0032] Accordingly, the Al- Mg master alloy added into the second molten Al may be melted at a relatively lower temperature in comparison to Mg added into the first molten Al. Due to the above reduction in melting point, Mg may be fast and easily melted in the second molten Al. As described above, if the melting point of the Al- Mg master alloy is greatly lowered, a holding time for melting the Al- Mg master alloy may be less than the holding time for melting Mg in the first molten Al. As such, a processing time may be reduced.

[0033] Also, when the Al- Mg master alloy is added into the second molten Al, since Mg is added after Mg is completely alloyed with Al, the amount of a protective gas may be greatly reduced in comparison to the case when Mg is added into the first molten Al. Further, when the Al- Mg master alloy is added, although a protective gas such as SF₆ is not used, ignition of Mg in the second molten Al is greatly reduced. Accordingly, molten Al including Mg may be maintained clean without using a protective gas such as an SF₆ gas that causes an environmental problem and is high- priced. Since Mg is added into molten Al in the form of an Al- Mg master alloy, a high content of Mg may be stably added without causing a problem caused when Mg is directly added into the molten Al.

[0034] Stirring may be performed to sufficiently melt the Al-Mg master alloy added into the second molten Al. The stirring is already described above and thus is not described in detail here.

[0035] An Al-Mg alloy is prepared by sufficiently melting and then casting the Al-Mg master alloy in the second molten Al (S6). The casting method is already described above and thus is not described in detail here.

[0036] According to the present invention, the content of Mg added into the second molten Al may be calculated by using the amount of Al in the second molten Al before the Al-Mg master alloy is not added, and the contents of Al and Mg in the Al-Mg master alloy.

[0037] That is, when the Al-Mg master alloy is added into the second molten Al, Mg in the Al-Mg master alloy is diluted and the content of the diluted Mg may be represented as shown in the following mathematical expression.

[Mathematical Expression]

$$\frac{W_{Mg}}{(W_{mg} + W_{Al1} + W_{Al2})}$$

[0038] Here, W_{Mg} and W_{Al1} are the weights of Mg and Al in the Al- Mg master alloy, and W_{Al2} is the weight of Al in the second molten Al.

[0039] A desired content of Mg in the second molten Al may be achieved by using the above mathematical expression.

[0040] In the present invention, the content of Mg in the Al-Mg master alloy has a relatively high value in comparison to that in the Al-Mg alloy, and the Al-Mg alloy has a relatively low content of Mg due to dilution according to the above mathematical expression.

[0041] For example, the content of Mg in the Al-Mg master alloy may have a range of 5 to 40wt%, and the content of Mg diluted in the Al-Mg alloy may have a range of 1 to 15wt% range, and particularly, 2 to 12wt%, and more particularly, 5 to 10wt%. The content of Mg in the Al-Mg alloy may be constantly maintained in an extruded material prepared by extruding the Al-Mg alloy.

[0042] According to the present invention, an Al-Mg master alloy having a high content of Mg may be prepared first, and then an Al-Mg alloy as much as an inverse ratio of a dilution ratio of the Al-Mg master alloy may be prepared. For

example, when 100g of an Al-Mg master alloy having 40wt% of Mg is prepared, if a dilution ratio is 0.25, a total of 400g of an Al-Mg alloy having 10wt% of Mg may be prepared.

[0043] In this case, a protective gas is used only when the Al-Mg master alloy is prepared. After the Al-Mg master alloy is prepared, the protective gas does not need to be used to prepare the Al-Mg alloy by diluting the Al-Mg master alloy. Accordingly, an Al-Mg alloy having a high content of Mg may be easily prepared by minimizing the use of a protective gas such as an SF₆ gas that is high-priced and causes an environmental problem.

[0044] A processed material (or a wrought material) prepared by processing the Al-Mg alloy casted according to the present invention has superior mechanical properties to a conventional commercial alloy. For example, the Al-Mg alloy according to an embodiment of the present invention may be provided as a processed material such as an extruded Al-Mg material or a rolled Al-Mg material.

[0045] The extruded Al-Mg material may be prepared by extruding the above-described Al-Mg alloy by using an extrusion apparatus. For example, the Al-Mg alloy may be put into a container, may be passed through dies by using a stem, and thus may be extruded to a predetermined shape. The extruded Al-Mg material may be prepared in various shapes, for example, a rod shape or a plate shape.

[0046] Since the Al-Mg alloy having a high content of Mg and a high casting quality is used, if process-hardening is added due to extrusion, the extruded Al-Mg material may have an excellent processability as well as excellent tensile strength properties.

[0047] The rolled Al-Mg material may be prepared by rolling the above-described Al-Mg alloy by using a rolling apparatus. For example, the Al-Mg alloy may be loaded between rollers and may be rolled to a predetermined shape by rotating the rollers.

[0048] Since the Al-Mg alloy having a high content of Mg and a high casting quality is used, if process-hardening is added due to rolling, the rolled Al-Mg material may have an excellent processability as well as excellent tensile strength properties.

[0049] Examples will now be provided for better understanding of the present invention. However, the following examples are provided merely to achieve better understanding of the present invention and do not limit the present invention.

[0050] FIGS. 4A and 4B are images showing extrusion states when an Al-Mg alloy prepared by diluting an Mg-Al master alloy according to the present invention (Example 1) and an Al-Mg alloy prepared by directly adding Mg (Comparative Example 1) are extruded.

[0051] In this case, the content of Mg in both of Example 1 and Comparative Example 1 is 10wt%, and the content of Mg in the Al-Mg master alloy used in Example 1 is 38wt%. Also, in both of Example 1 and Comparative Example 1, molten metal is continuous casted and then extruded to a form of a rod having a cross-sectional diameter of 180mm.

[0052] Referring to FIGS. 4A and 4B, Example 1 shows a very good extruded material having no cracks or abnormal defects. On the other hand, Comparative Example 1 shows that serious damage is caused due to a plurality of casting cracks generated during extrusion.

[0053] As such, it is shown that, in comparison to the Al-Mg alloy prepared by using a conventional method, the Al-Mg alloy prepared according to the present invention has a very good processability in spite of a high content of Mg, for example, 10wt%. Therefore, according to the present invention, an Al-Mg alloy having a high content of Mg, for example, 5wt% or above, which was not substantially commercialized due to a poor processability, may be prepared with an excellent processability.

[0054] In Example 1, since Mg is added into molten Al in the form of the Al-Mg master alloy, although a protective gas such as an SF₆ gas is not used, the molten Al may be maintained in a very good state and thus the Al-Mg alloy may also be in a very good state after being casted. Accordingly, considering that the Al-Mg alloy having a high content of Mg, for example, 10wt%, is prepared without using a protective gas such as an SF₆ gas in Example 1, the method of producing an Al-Mg alloy, according to the present invention, is very economical and efficient.

[0055] FIGS. 5A and FIG. 5B are an image and a graph showing a microstructure and a tensile test result of an Al-Mg alloy casted according to the present invention.

[0056] FIG. 5A is an optical microscopic image of an internal structure of an Al-Mg alloy prepared by using the same method used in Example 1 except that mold casting is performed (Example 2). Referring to FIG. 5A, the Al-Mg alloy of Example 2 has a very good structure in which an impurity such as an oxide or another inclusion generated due to oxidation of Mg in molten metal is not found.

[0057] The Al-Mg alloy of Example 2 has remarkably superior mechanical properties to a commercial Al-Mg alloy. FIG. 5B shows tensile properties of the Al-Mg alloy of Example 2, and Table 1 shows mechanical properties of the Al-Mg alloy of Example 2 and an AC7A-F alloy that is a commercial Al-Mg casting alloy, according to the KS D 6008 standards.

[Table 1]

	Content of Mg	Tensile Strength (MPa)	Elongation (%)
Example 2	10wt%	233	12
AC7A-F	3.5 to 5.5wt%	210	12

[0058] As shown in FIG. 5B and Table 1, the Al-Mg alloy of Example 2 has a superior tensile strength and an equivalent elongation to the AC7A-F alloy.

[0059] In the Al-Mg alloy prepared by using a conventional method, if Mg is increased to a high content, casting cracks are generated and thus a poor elongation is achieved. However, the Al-Mg alloy of Example 2 has a high content of Mg (10wt%) more than double that of the AC7A-F alloy and has a superior tensile strength and an equivalently excellent elongation to the AC7A-F alloy.

[0060] Considering that the Al-Mg alloy having a high content of Mg, for example, 10wt%, is prepared without using a protective gas such as an SF₆ gas in Example 2, the method of producing an Al-Mg alloy, according to the present invention, is very economical and efficient.

[0061] FIG. 6 is a graph showing tensile test results of an extruded material prepared by extruding the Al-Mg alloy of Example 2 (Example 3), and an extruded material prepared by extruding a 5052 alloy that is a commercial Al alloy. Table 2 shows mechanical properties of the extruded material of Example 3 and the extruded material of the 5052 alloy.

[Table 2]

	Tensile Strength (MPa)	Yield Strength (MPa)	Elongation (%)
Example 3	399	221	38.2
Extruded Material of 5052	211	87	23.7

[0062] Referring to FIG. 6 and Table 2, the extruded material of Example 3 has remarkably superior mechanical properties to the extruded material of the 5052 alloy. That is, the extruded material of Example 3 has a greatly higher tensile strength and a quite higher elongation than the extruded material of the 5052 alloy.

[0063] As described above, since processability is greatly reduced if the content of Mg in an Al-Mg alloy is high, a 5000-series alloy that is a commercial Al-Mg alloy for preparing a processed material is designed to have a content of Mg less than 5.5wt%. However, the extruded material of Example 3 in which the content of Mg is 10wt% has remarkably superior elongation and strength properties to the extruded material of the 5052 alloy in which the content of Mg is 2.2 to 2.8wt%.

[0064] FIG. 7 is an optical microscopic image of a microstructure of the extruded material of Example 3. As shown in FIG. 7, the extruded material of Example 3 has a microstructure in which very fine grains are uniformly distributed. These excellent mechanical properties of the extruded material may be achieved due to a combination of good mechanical properties of a casting alloy having a high solubility of Mg and an effect of a microstructure in which fine grains are uniformly distributed after being processed.

[0065] FIG. 8 is a graph showing tensile test results of a rolled material prepared by rolling the Al-Mg alloy of Example 2 (Example 4), and a rolled material prepared by rolling a 5052 alloy that is a commercial Al alloy. Table 3 shows contents and mechanical properties of the rolled material of Example 4 and the rolled material of the 5052 alloy. In this case, a reduction ratio of the rolling process is 83%.

[Table 3]

	Tensile Strength (MPa)	Yield Strength (MPa)	Elongation (%)
Example 4	563	489	18.1
Rolled Material of 5052	220	203	13.2

[0066] As shown in FIG. 8 and Table 3, the rolled material of Example 4 has remarkably superior tensile strength, yield strength, and elongation to the rolled material of the 5052 alloy. That is, the rolled material of Example 4 has a higher tensile strength and a higher elongation than the rolled material of the 5052 alloy having a low content of Mg.

[0067] As described above, since processability is greatly reduced if the content of Mg in an Al-Mg alloy is high, a 5000-series alloy that is a commercial Al-Mg alloy for preparing a processed material is designed to have a content of Mg less than 5.5wt%. However, the rolled material of Example 4 in which the content of Mg is 10wt% has remarkably

superior elongation and strength properties to the rolled material of the 5052 alloy in which the content of Mg is 2.2 to 2.8wt%.

[0068] FIG. 9 is an optical microscopic image of a microstructure of the rolled material of Example 4. As shown in FIG. 9, the rolled material of Example 4 has a microstructure in which very fine grains are uniformly distributed. These excellent mechanical properties of the rolled material may be achieved due to a combination of good mechanical properties of a casting alloy having a high solubility of Mg and an effect of a microstructure in which fine grains are uniformly distributed after being processed.

[0069] The above-described Al-Mg alloy and the method of producing a processed material of the Al-Mg alloy, according to embodiments of the present invention, may be applied to various Al alloys and processed materials prepared by processing them. For example, when a casting alloy based on an Al-Mg alloy or a 5000-series or 6000-series Al-Mg alloy for a processed material is prepared, by adding Mg in the form of an Al-Mg master alloy instead of directly adding Mg, oxidation of Mg in molten Al may be prevented and thus excellent castability or mechanical properties may be ensured.

[0070] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

Claims

1. A method of producing an aluminum (Al)- magnesium (Mg) alloy, the method comprising:
 - adding Mg into first molten Al;
 - preparing an Al-Mg master alloy having a first Mg content by casting the first molten Al in which Mg is added;
 - adding the Al-Mg master alloy into second molten Al; and
 - casting an Al-Mg alloy having a second Mg content less than the first Mg content, by casting the second molten Al.
2. The method of claim 1, wherein a holding time for melting the Al-Mg master alloy in the adding of the Al-Mg master alloy is less than the holding time for melting the Mg in the adding of the Mg.
3. The method of claim 1, wherein a melting point of the Al-Mg master alloy is less than the melting point of the Mg by 100 to 200°C.
4. The method of claim 1, wherein the second Mg content is 2 to 12wt%.
5. The method of claim 1, wherein the first Mg content is 5 to 40wt%.
6. The method of claim 1, wherein an amount of a protective gas used to prevent ignition of the Mg in the adding of the Mg is greater than the amount of the protective gas used in the adding of the Al-Mg master alloy.
7. The method of claim 1, wherein a protective gas is used to prevent ignition of the Mg in the adding of the Mg, and wherein the protective gas is not used in the adding of the Al-Mg master alloy.
8. The method of claim 1, wherein an SF₆ gas is not used as a protective gas in the adding of the Al-Mg master alloy.
9. The method of any one of claims 1 to 8, further comprising extruding the Al-Mg alloy.
10. The method of any one of claims 1 to 8, further comprising rolling the Al-Mg alloy.
11. A method of producing an aluminum (Al)- magnesium (Mg) alloy, the method comprising:
 - providing an Al- Mg master alloy having a first Mg content;
 - adding the Al-Mg master alloy into molten Al; and
 - casting an Al-Mg alloy having a second Mg content less than the first Mg content by casting the molten Al, wherein a melting point of the Al-Mg master alloy is less than the melting point of pure Mg by 100 to 200°C.
12. The method of claim 11, wherein the adding of the Al-Mg master alloy is performed without using a protective gas for preventing ignition of Mg.

13. The method of claim 11, further comprising extruding or rolling the Al-Mg alloy.

14. An aluminum (Al)- magnesium (Mg) alloy prepared by adding an Al- Mg master alloy having a first Mg content into molten Al and then casting the molten Al, so as to have a second Mg content less than the first Mg content.

15. The Al-Mg alloy of claim 14, wherein the Al-Mg alloy has a higher tensile strength and an equivalent or higher elongation in comparison to a commercial Al-Mg alloy having a lower Mg content.

16. The Al-Mg alloy of claim 14, wherein the first Mg content is 5 to 40wt%, and the second Mg content is 2 to 12wt%.

FIG. 1

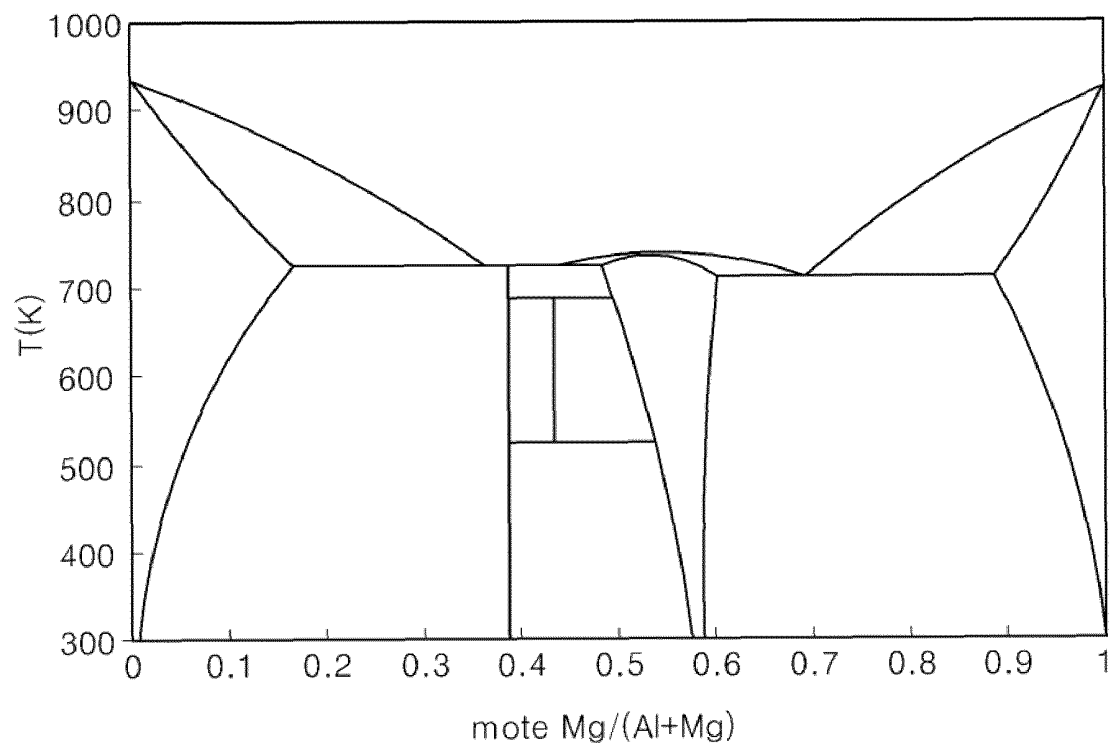


FIG. 2

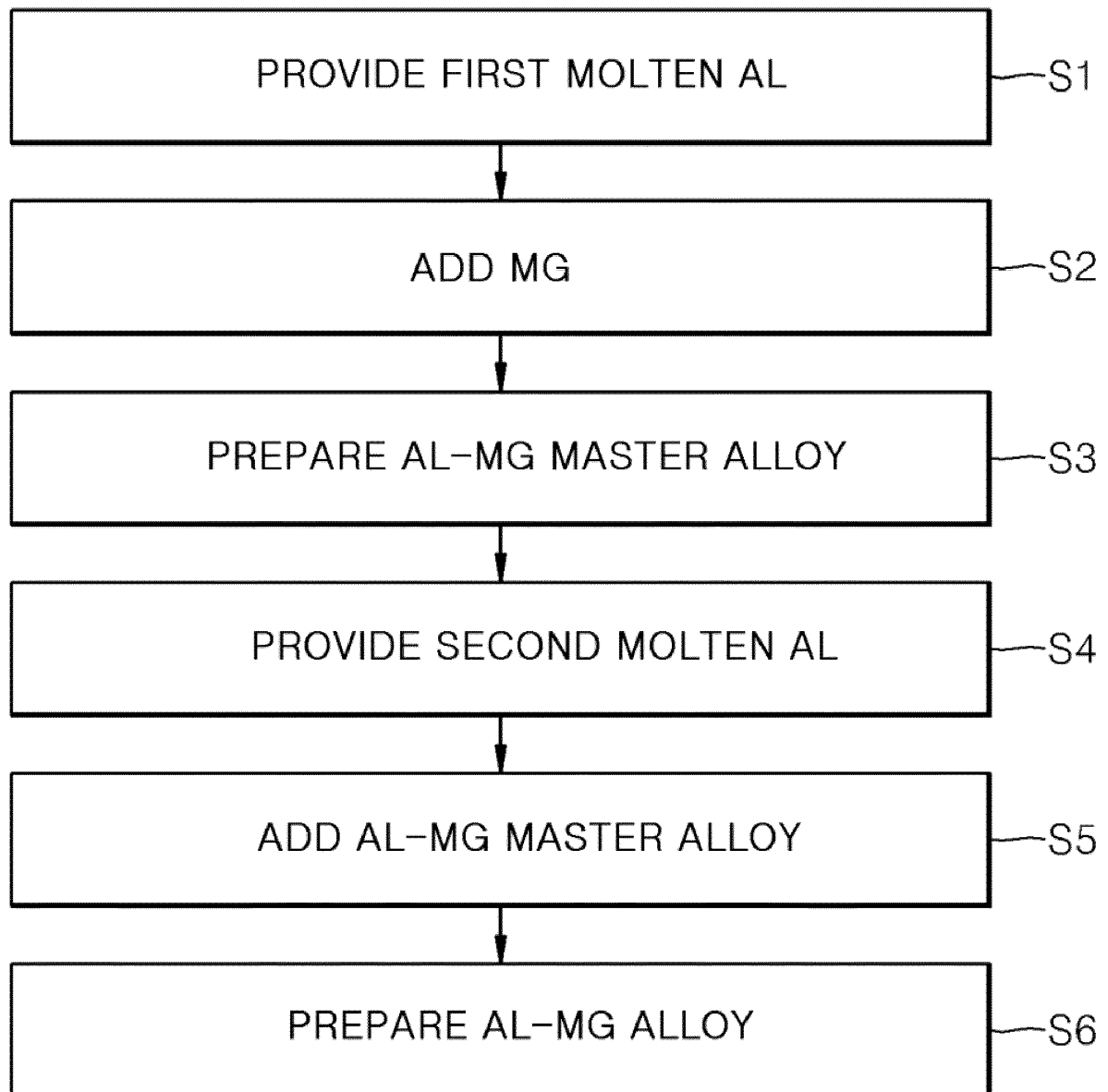


FIG. 3a

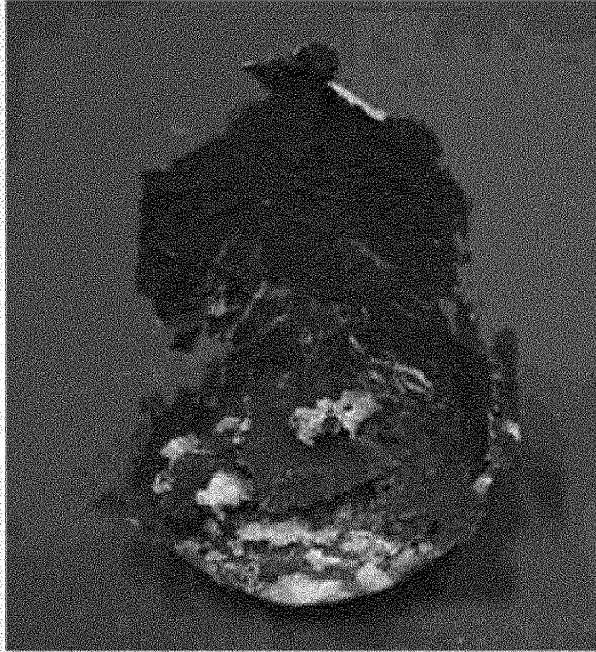


FIG. 3b

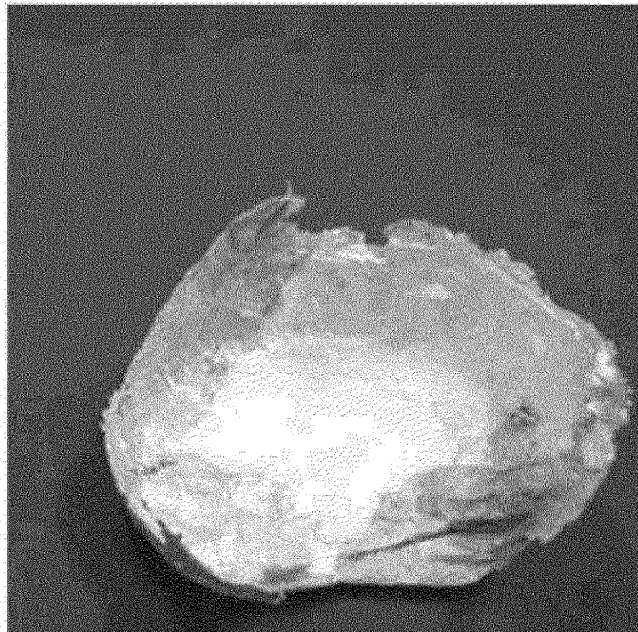


FIG. 4a

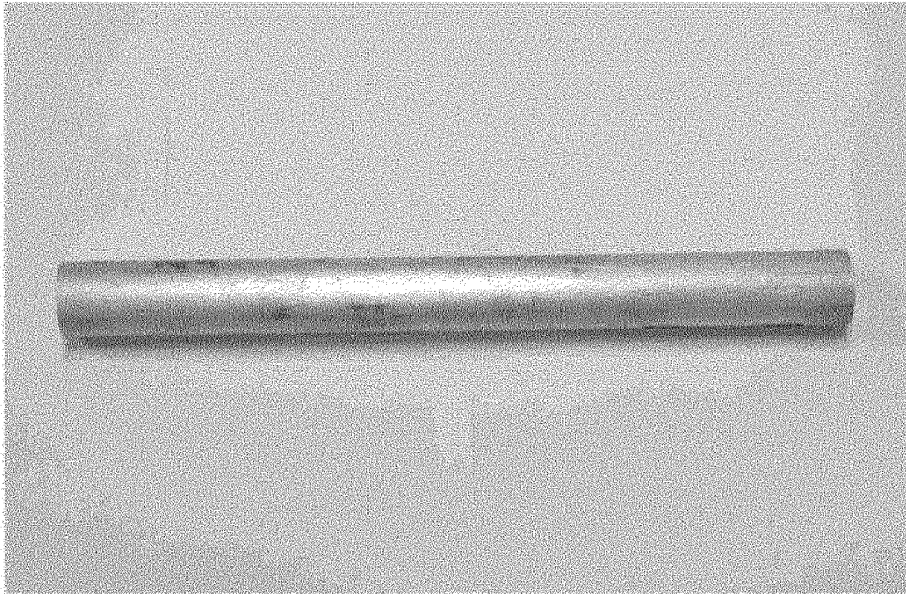


FIG. 4b

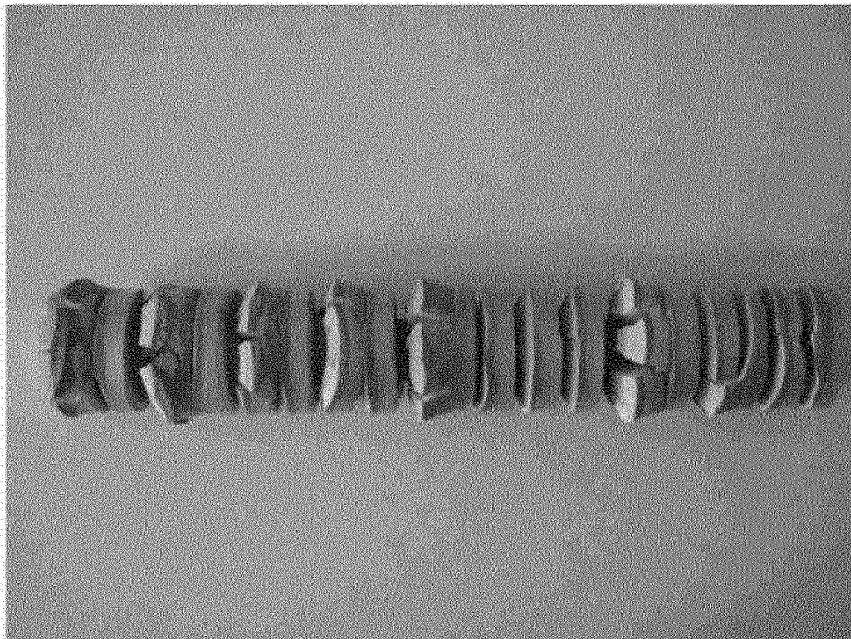


FIG. 5a

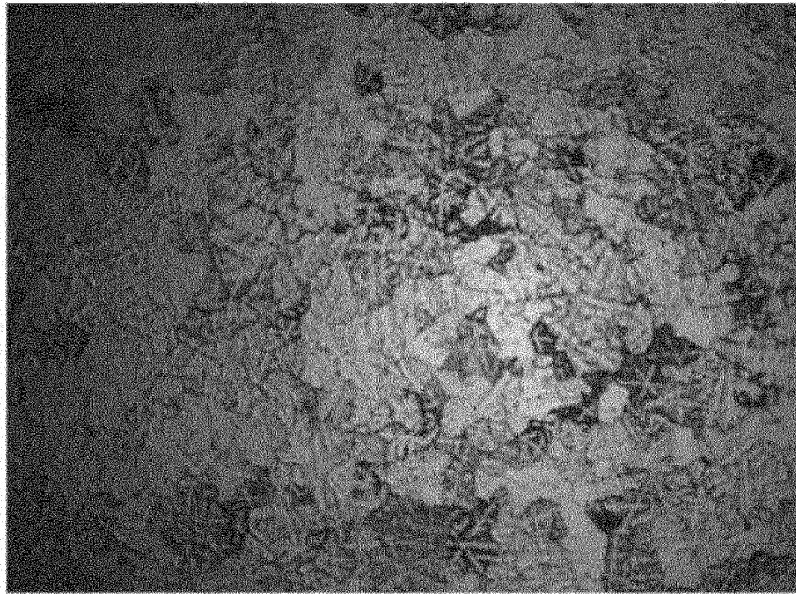


FIG. 5b

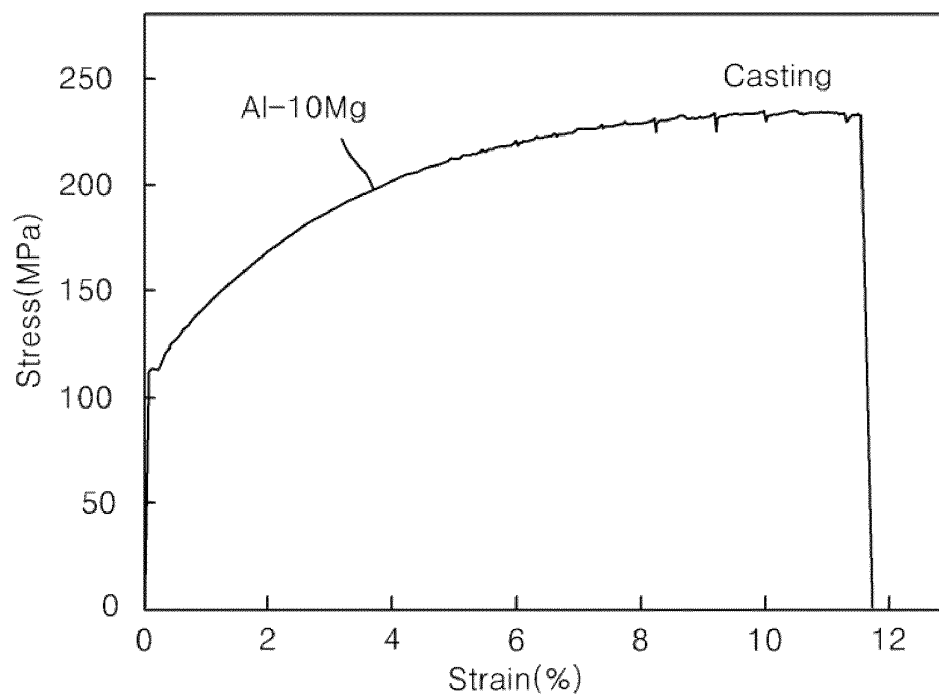


FIG. 6

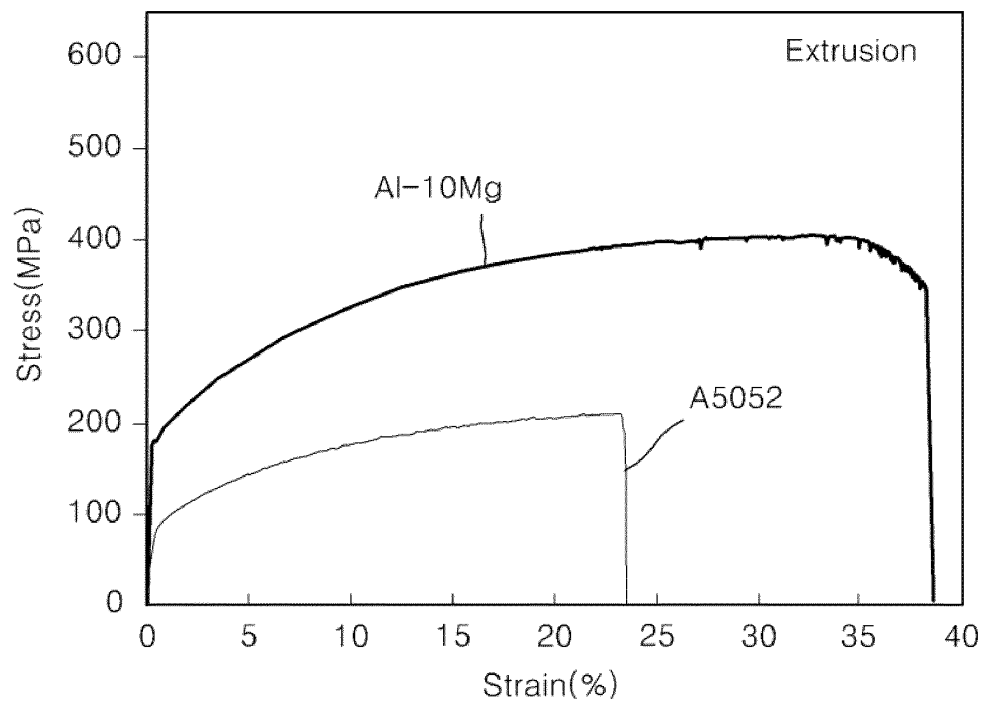


FIG. 7

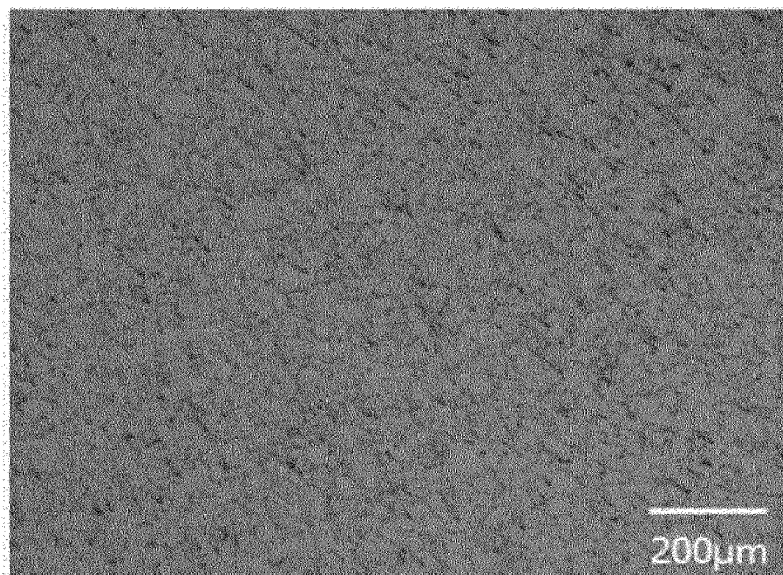


FIG. 8

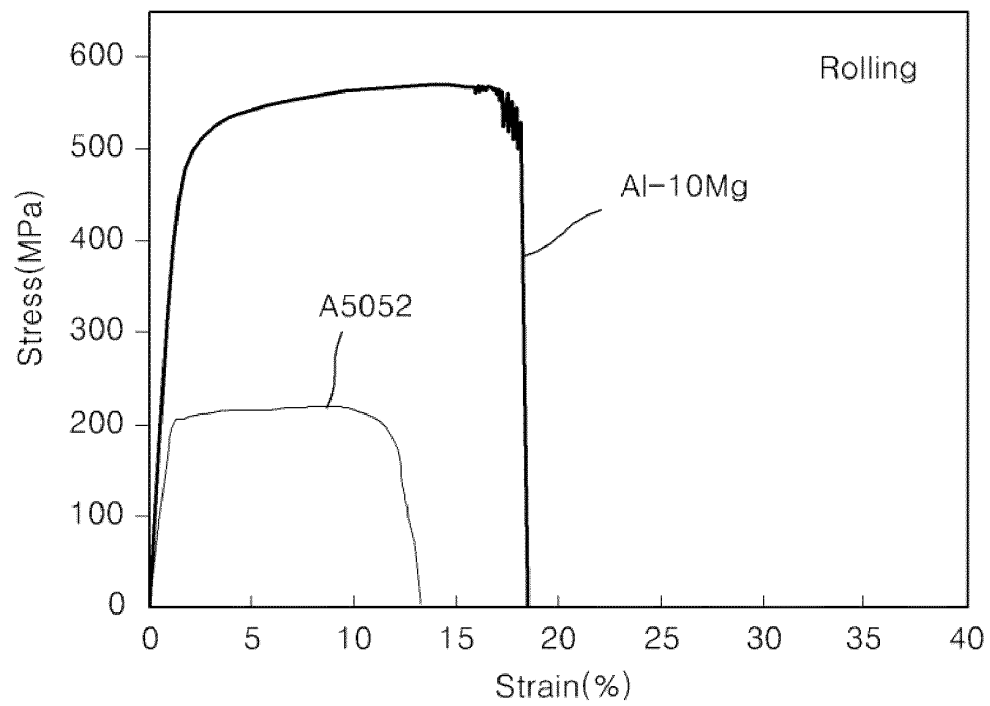


FIG. 9

