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(54) **ALUMINUM ALLOY PRODUCT AND MANUFACTURING METHOD THEREFOR**

(57) The present invention relates to an aluminium alloy and a process of producing the same, wherein the aluminium alloy comprises Al, Si, Fe, Mg, Cu, Ti and optionally other impurities, characterized in that the components are comprised in amounts by weight of: Si: 0.04-0.1%, Fe: 0.2-0.4%, Mg: 0.055-0.12%, Cu: 0.004-0.01%, Ti: 0.003-0.02%; any one of the other impurities is in an amount by weight of no more than 0.03%; and the balance is Al. The present invention also relates an article comprising the aluminium alloy, the use of the aluminium alloy article for printing plate, and a process of producing an aluminium alloy sheet/strip/foil for printing plate using the aluminium alloy.

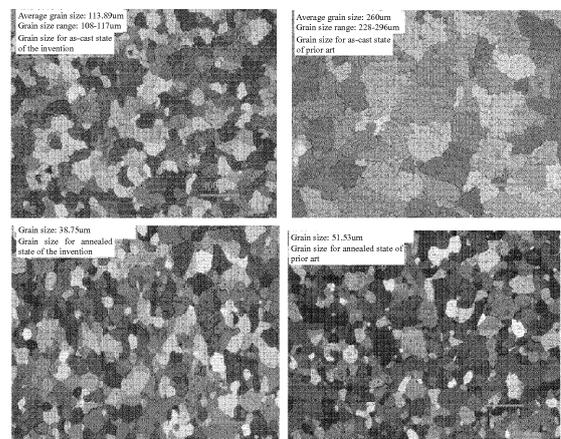


Fig. 1

Description

Technical field

5 **[0001]** The present invention relates to an aluminium alloy, which is useful for printing plate making, especially for (computer) direct-to-plate. The invention also relates to an article produced from the alloy, which article is, e.g., in the form of sheet, strip or foil, and to a process of producing same.

Background

10 **[0002]** In the recent years, as the development of the printing technology, the printing plate is changing from presensitized plate (PS plate) to computer-to-plate (CTP plate). Meanwhile, the printing requires stringently on the plate, where the CTP technology requires particularly stringently on the CTP plate and the properties of the aluminium alloy sheet, strip or foil to produce the CTP plate, such as the appearance properties, physical properties and adaptability to electrolysis. In particular, the current CTP plates are generally used for high grade of color printing plate-making. In order to ensure the plate quality, the properties of the plate substrate are the foundation. The printing field generally requires the follows:

20 1) requirements on dimensions of the aluminium alloy sheet/strip/foil;

a) thickness and tolerance

The aluminium alloy sheet/strip/foil useful for CTP plate requires a thickness of 0.14mm-0.50mm, and a tolerance of ± 0.005 mm;

b) tolerance of width

25 The aluminium alloy sheet/strip/foil requires a tolerance of width of $\leq \pm 0.5$ mm; and

c) uniformity in the longitudinal and transversal directions

30 The aluminium alloy sheet/strip/foil requires tolerances of thickness in both longitudinal and transverse directions of $\leq \pm 0.005$ mm. The current plate-making machine sets generally a thickness of 0.280mm or 0.275mm for the plate, then the variation in the longitudinal or transverse direction will affect adversely to the plate-making. Also, the settings of the CTP plate-making device are usually unallowable for adjustment arbitrarily.

2) requirements on appearance of the aluminium alloy sheet/strip/foil

35 The appearance of the aluminium alloy sheet/strip/foil is required to be clean and smooth; have no defects of crack, corrosion hole, corrosion spot, through hole, scratch, fold, impression, peeling, pine pattern mark or oil mark; have no press-in mark by a non-metal, sticking mark, peeling or wave on the surface; have no chromatic aberration or highlighting band; and have no swelling or wavy edges.

3) requirements on the mechanical properties of the aluminium alloy sheet/strip/foil

40 a) the aluminium sheet for the CTP plate must have good mechanical properties and good properties after baking.

b) the CTP plate usually uses an automatic plate loading and an automatic positioning and punching device, requiring the plate with a stiffness. If the plate is too soft, the stiffness is lower, and the plate is readily bent to affect adversely the going up of edition material. If the aluminium sheet is too hard, it is difficult to level the plate.

4) requirements on the electrolytic properties of the aluminium alloy sheet/strip/foil

45 As the CTP plate is usually used for high grade color printing, the grain of the substrate of the CTP plate is lower than that of the PS plate. In particular, the CTP plate-making device generally uses a FM screening or FM/AM mixed screening, such that the reduction of fine screen dot and screen line is associated directly with the surface roughness of the substrate, i.e., the grain of the substrate. The greater the grain is, the worse the reduction of the screen dot and screen line is. In order to obtain a layer with fine and uniform grain through electrolysis, the appearance quality and the surface roughness of the substrate should be focused. If the appearance quality of the substrate is too bad, the defects of the plate surface cannot be eliminated without a strengthened electrolysis, resulting in a greater grain. If the substrate has a $Ra \geq 0.30 \mu\text{m}$, it is difficult to obtain a lower grain.

50 In order to obtain a layer with fine and uniform grain, the inherent composition of the aluminium substrate is the core. That is, the components of the aluminium alloy to produce the aluminium plate are interested, which, in turn, are associated with the composition and contents of the specific metals of the aluminium alloy. The process of preparing or treating the aluminium alloy is also concerned.

55 A good aluminium alloy sheet/strip/foil requires not only good mechanical properties but also good adaptability to electrolysis, so as to be useful for electrolysis with hydrochloric acid or nitric acid electrolyte. A sensitivity of grain

EP 3 159 421 A1

corresponding to the electrolysis is also required, so as to form a layer with fine and uniform grain without a strengthened treatment.

5) requirements on the planeness of the aluminium alloy sheet/strip/foil

The aluminium alloy sheet/strip/foil for the CTP requires a high planeness, as most of the CTP apparatuses use scanning imaging, different from the printing-down for the PS plate where a vacuum is applied to tight the plate with the film. Then, if the plate has a poor planeness, the quality of the imaging by laser will be affected adversely. Therefore, the aluminium alloy sheet/strip/foil for CTP requires stringently on the planeness.

[0003] For the production of an aluminium alloy sheet/strip/foil, some factors are generally controlled, comprising:

- 1. Controlling the contents of the trace elements, so as to improve the mechanical properties and the grain properties by electrolysis;
- 2. Using a homogenous annealing at a high temperature, so as to improve the internal structure of the product; and
- 3. Using appropriate intermediate annealing temperature and period for cold rolling, for the desired mechanical properties of the product.

[0004] Currently, in the market of aluminium alloy sheet/strip/foil for CTP print, the AA1050 alloy is popularly used. For the AA1050 alloy, those skilled persons can refer to "Quality Requirements and Typical Defects Analysis of Aluminium Material for CTP", Aluminium Fabrication, 2008.3, Vol. 182, such as the aluminium substrate introduced. The quality of electrochemical roughening is affected by a plurality of factors, such as the electric current density, the linear velocity, the chemical components and the like. In order to obtain a better roughened surface, an AA1050 alloy is generally used, where the content of aluminium is controlled to be 99.5% or more.

[0005] For the currently usual AA1050 alloy, the components of the alloy are controlled as follows:

Si (Max)	0.25
Fe (Max)	0.4
Cu (Max)	0.05
Mn (Max)	0.05
Mg (Max)	0.05
Zn (Max)	0.05
V (Max)	0.05
Ti (Max)	0.03
Other Each (Max)	0.03
Others Total	--
Al(Min)	99.50

[0006] The controlling standard can refer to the International Designations Chemical Composition Limits for Unalloyed Aluminium, 2003, edited by The Aluminium Association, USA, see www.aluminium.org.

[0007] The CTP substrate prepared according to the Table above comprises the typical mechanical properties of: a tensile strength of 130-150MPa, a yield strength of 120-140MPa, and an elongation of 1.0-3.0%, at room temperature; and a tensile strength of 120-130MPa, a yield strength of 110-120MPa, and an elongation of 2.0-3.5%, at a baking temperature. It can be seen that the properties are not so stable, decreasing the printing quality.

[0008] As the CTP plate is usually used for high grade color printing, the grain of the substrate of the CTP plate is lower than that of the PS plate. In particular, the CTP plate-making device generally uses a FM screening or FM/AM mixed screening, such that the reduction of fine screen dot and screen line is associated directly with the surface roughness of the substrate, i.e., the grain of the substrate. The greater the grain is, the worse the reduction of the screen dot and screen line is. The AA1050 alloy has poor uniformity for the internal structure, such that the electrolysis properties are undesirable, and the grains after electrolytic roughening are not uniform, resulting too poor reduction to satisfy the requirement by the high grade of CTP plate.

Summary of the Invention

[0009] Regarding the problems of the prior art above, it is one of the objects of the present invention to provide a process of producing aluminium sheet/strip/foil for printing plate. The aluminium sheet/strip/foil has a uniform internal structure, such that besides the high surface quality and good planeness of the plate, the sheet/strip/foil has improved mechanical properties at room temperature and improved mechanical properties at a baking temperature, and also can generate an excellent grain structure through electrolysis.

[0010] Accordingly, the present invention provides an aluminium alloy for printing plate, comprising Al, Si, Fe, Mg, Cu, Ti and other impurities, characterized in that the components are comprised in amounts by weight of: Si: 0.04-0.1%, Fe: 0.2-0.4%, Mg: 0.055-0.12%, Cu: 0.004-0.01%, Ti: 0.003-0.02%; any one of the other impurities is in an amount by weight of no more than 0.03%; and the balance is Al. $Mg/Fe \geq 0.125$.

[0011] The present invention also provides a process of producing an aluminium alloy article for printing plate, characterized in comprising the steps of:

1) adding raw materials of the alloy into a remelting furnace, melting, refining, inclusion removing, degassing and filtering, followed by casting into a sheet ingot with a thickness of about 500 to about 650 mm;

2) sawing the head and butt of the sheet ingot, scalping, and then heating to a temperature of about 500 to about 600 degrees centigrade for about 2 to about 12 hours; and hot rolling the sheet ingot into a strip with a thickness of about 2.0 to about 5.0 mm at a finish rolling temperature of about 250 to about 320 degrees centigrade;

3) cold rolling the strip to a thickness of about 1 to about 3 mm, wherein the roll has a roughness, Ra, of about 0.30 to about 0.80 μm ;

4) annealing the cold rolled strip from step 3) in an annealing furnace at a temperature of about 350 to about 450 degrees centigrade, and holding the temperature for about 2 to about 4 hours;

5) continuing rolling the strip from step 4) on a cold rolling machine to a thickness of about 0.14 to about 0.4 mm, with a Ra of about 0.15 to about 0.30 μm ; and

6) cleaning the strip from step 5), edge trimming, and tension leveling, to obtain the aluminium alloy article for printing plate according to the present invention, which is in the form of, e.g., strip, foil or sheet.

[0012] Accordingly, the present invention also provides an aluminium alloy sheet/strip/foil for printing plate produced by the process above, which sheet/strip/foil comprises the aluminium alloy according to the present invention.

[0013] The aluminium alloy sheet/strip/foil has a thickness of about 0.14 mm to about 0.50 mm, preferably 0.20 to 0.38 mm, such as about 0.220 mm to about 0.275 mm.

[0014] The aluminium alloy article (such as an aluminium alloy strip) according to the present invention has a tensile strength of about 175 to about 210MPa, a yield strength of about 170 to about 200MPa, and/or an elongation of about 2% to about 6%, at room temperature.

[0015] Through a simulated baking condition treatment at a temperature of 240 degrees centigrade for 10 minutes, the aluminium alloy article, after cooling, has a tensile strength of about 145 to about 170MPa, a yield strength of about 135 to about 155MPa, and/or an elongation of about 3% to about 8%.

Description of Drawings

[0016]

Fig.1: comparison of crystal grains in the as-cast state and grains after annealing between the alloy strip produced by Example 1 according to the present invention and an alloy sheet produced by AA1050 alloy from prior art.

Fig.2: comparison of grain precipitation of the intermetallic compounds (the second phase) between the alloy strip produced by Example 1 according to the present invention and an alloy sheet produced by AA1050 alloy from prior art.

Fig.3: comparison of grains between the alloy strip produced by Example 1 according to the present invention and an alloy sheet produced by AA1050 alloy from prior art.

Fig.4: comparison of article etching between the alloy strip produced by Example 1 according to the present invention

and an alloy sheet produced by AA1050 alloy from prior art.

Fig.5: comparison of images after graining between the alloy strip produced by Examples 1 to 5 according to the present invention and an alloy sheet produced by AA1050 alloy from prior art; under the test conditions of SEM×250, and a line speed of 50m/min, 60m/min, 70m/min, and 80m/min, respectively.

Fig.6: comparison of images after graining between the alloy strip produced by Examples 1 to 5 according to the present invention and an alloy sheet produced by AA1050 alloy from prior art; under the test conditions of SEM×1000, and a line speed of 50m/min, 60m/min, 70m/min, and 80m/min, respectively.

Fig.7: comparison of etching in the graining electrolytes between the alloy strip produced by Examples 1 to 5 according to the present invention and an alloy sheet produced by AA1050 alloy from prior art; under the test conditions of: etching after 5 seconds of deoiling, SEM×40 magnifications.

Fig.8: comparison of corrosion etching in the graining electrolytes between the alloy strip produced by Examples 1 to 5 according to the present invention and an alloy sheet produced by AA1050 alloy from prior art; under the test conditions of: etching after 5 seconds of deoiling, SEM×250 magnifications.

Embodiments of the invention

[0017] The present invention provides an aluminium alloy for printing plate, comprising Al, Si, Fe, Mg, Cu, Ti and other impurities, characterized in that the components are comprised in amounts by weight of: Si: 0.04-0.1%, Fe: 0.2-0.4%, Mg: 0.055-0.12%, Cu: 0.004-0.01%, Ti: 0.003-0.02%; any one of the other impurities is in an amount by weight of no more than 0.03%; and the balance is Al. $Mg/Fe \geq 0.125$.

[0018] In an embodiment, Si is preferably used in an amount of not less than 0.05%, more preferably not less than 0.06%. In an embodiment, Si is preferably used in an amount of not more than 0.10%, more preferably not more than 0.08%.

[0019] In an embodiment, Fe is used in an amount of not less than 0.21%, preferably not less than 0.25%, more preferably not less than 0.3%. In an embodiment, Fe is preferably used in an amount of not more than 0.39%, more preferably not more than 0.38%.

[0020] In an embodiment, Mg is preferably used in an amount of not less than 0.06%, more preferably not less than 0.07%. In an embodiment, Mg is preferably used in an amount of not more than 0.11%, more preferably not more than 0.10%.

[0021] In an embodiment, Cu is preferably used in an amount of not less than 0.0045%, more preferably not less than 0.005%. In an embodiment, Cu is preferably used in an amount of not more than 0.009%, more preferably not more than 0.008%.

[0022] In an embodiment, Ti is preferably used in an amount of not less than 0.004%, more preferably not less than 0.005%. In an embodiment, Ti is preferably used in an amount of not more than 0.017%, more preferably not more than 0.015%.

[0023] The aluminium alloy according to the present invention may comprise the typical impurities in the art, such as Li, Na, Pb, Be, Zn, or V, where the amount of any one impurity is in an amount by weight of not more than 0.03%. Preferably, the total amount of the impurities is at most 0.1 wt%. The aluminium alloy according to the present invention comprises Al in an amount of not less than 99.30%.

[0024] The aluminium alloy according to the present invention can be produced by a process known in the art, according to the formulation above. A typical producing process comprises, for example:

- 1) melt casting - scalping - annealing - hot rolling - cold rolling - annealing - cold rolling - tension leveling - packaging; or
- 2) cast rolling - cold rolling - tension leveling - packaging.

[0025] The aluminium alloy sheet/strip/foil according to the present invention can be used for CTP printing plate, bottle cap, sheet for soft tube, curtain wall panel, decoration board, case of an electric equipment, heat exchanger, wrapper of electric cable, extrusion coil, powder for fireworks, nameplate, light-reflecting device, thermal isolation aluminium foil and so on.

[0026] The aluminium alloy according to the present invention can be particularly used to produce an aluminium alloy sheet/strip/foil for printing plate (including a treatment-free printing plate). Accordingly, the present invention also provides a process of producing an aluminium alloy sheet/strip/foil for printing plate, characterized in comprising the steps of:

- 1) adding raw materials of the alloy into a remelting furnace, melting, holding, refining, degassing and filtering,

followed by casting into a sheet ingot with a thickness of about 500 to about 650 mm;

2) sawing the head and butt of the sheet ingot, scalping, and then heating to a temperature of about 500 to about 600 degrees centigrade for about 2 to about 12 hours; and hot rolling the sheet ingot into a strip with a thickness of about 2.0 to about 5.0 mm at a temperature of about 250 to about 320 degrees centigrade;

3) cold rolling the strip obtained in step 2) to a thickness of about 1 to about 3 mm, wherein the roll has a roughness, Ra, of about 0.30 to about 0.80 μm ;

4) annealing the cold rolled strip from step 3) in an annealing furnace at a temperature of about 350 to about 450 degrees centigrade for an intermediate annealing, and holding the temperature for about 2 to about 4 hours;

5) continuing rolling the strip from step 4) on a cold roller to a thickness of about 0.14 to about 0.50 mm, to provide a sheet, strip or foil with a Ra of about 0.15 to about 0.30 μm ; and

6) cleaning the sheet, strip or foil from step 5), edge trimming, and tension leveling, to obtain the aluminium alloy sheet /strip/ foil for printing plate according to the present invention.

[0027] In an embodiment, the remelting furnace has a temperature of about 720 to 740 degrees centigrade. The sheet ingot has preferably a thickness of not less than about 520mm. The sheet ingot has preferably a thickness of not more than about 620mm.

[0028] Accordingly, the present invention also provides an aluminium alloy article produced by the process above for printing plate, such as in the form of sheet/strip/foil, which comprises the aluminium alloy according to the present invention.

[0029] In an embodiment, the alloy strip has a thickness of about 0.27mm.

[0030] In an embodiment, the aluminium alloy strip has a tensile strength at room temperature of about 175 to about 210MPa, preferably about 185MPa. In an embodiment, the aluminium alloy strip has a yield strength at room temperature of about 170 to about 200MPa, preferably about 180MPa. In an embodiment, the aluminium alloy strip has an elongation at room temperature of about 2 to about 6%, preferably about 2 to about 3.5%.

[0031] In an embodiment, through a simulated baking condition treatment at a temperature of 240 degrees centigrade for 10 minutes, the aluminium alloy strip, after cooling, has a tensile strength of about 145 to about 175 MPa, preferably about 160 to about 175 MPa or about 160 to about 170 MPa; a yield strength of about 135 to about 155 MPa, preferably about 140 to about 150 MPa; and/or an elongation of about 3 to about 8%, preferably about 3 to about 6%.

[0032] The technical solution of the present invention can achieve beneficial technical effects, including, but not limited to, for example, the present invention capable of using a relatively lower homogenizing temperature to achieve a complete transition between a non-equilibrium phase and a equilibrium phase, which increases the utilization efficiency of heating furnace and saves the energy consumption; according to the present invention, homogeneously dispersed intermetallic compounds being precipitated, such that the electrolytic roughening occurs at more positions homogeneously and rapidly, the electrolyzing voltage is decreased and the electrolysis energy consumption is saved; the technical solution according to the present invention resulting in a clean surface, which can improve greatly the treatment efficiency before electrolysis and save the consumption of acid and base; and the technical solution according to the present invention resulting in high mechanical properties, such that a rapid plate loading can be achieved, the production efficiency can be increased, and the excellent baking performances improves greatly the durability.

Examples

[0033] The present invention will be illustrated through the following examples, which are exemplary but not restrictive.

Material :

[0034]

Electrolytic aluminium ingot A199.70, available from Aluminium Corporation of China Limited.

AMG grain refiner, available from London and Scandinavian metallurgical Co., Ltd. Company.

Intermediate alloy, 80Fe, 20Si, 50Cu, Ti5, available from Yongte Master Alloys Co., Ltd., Jiangxi.

Instruments and testing methods:

[0035]

Hydrogen gauge: HMA0100D, available from ABB, used to measure the hydrogen content of the melt.

Inclusion measuring instrument: PZM0700D, available from ABB, used to measure the slag content of the melt.

Scanning electron microscope: EVO18, available from Zeiss, Germany, with a test method of secondary electron,

EP 3 159 421 A1

backscattering.

Microscope: Zeiss Imager.A2m, available from Zeiss, Germany, with a test method of light field, polarized light.

Roughometer: Hommel Tester W55, available from Hommel, Germany, used for the roughness and Burr measurement.

5 Micrometer: Mitutoyo, available from Japan, used for thickness measurement.

Tensile testing machine: CMT6203/6503 electronic universal tensile testing machine, available from MTS, USA, referring to "GB 228 - 2002 Standard Test Method for tensile testing of metallic materials at room temperature".

Example 1

10

[0036] An aluminium alloy strip according to the present invention was produced according to the process illustrated below, referring to the example formulation as shown in Table 1:

15

(1) providing materials of: 108000kg of 99.7 aluminium ingot (containing 40kg of Si, 194kg of Fe, 1.1kg of Mg, 0.5kg of Cu), 15kg of AlSi20 alloy, 230kg of 80Fe agent, 63.5kg of Mg ingot, and 7.6kg of AlCu50 alloy; adding into a remelting furnace having a remelting temperature of 750 degrees centigrade, refining, inclusion removing, stirring, and analyzing and regulating the components, the composition listed in Table 1, adding into a stewing furnace, stewing, refining, degassing, inclusion removing, adding Al-5Ti-1B rods (1.2 ~ 1.4kg/t molten aluminium) and casting into a cast ingot in a casting machine at a casting temperature of 705 degrees centigrade;

20

(2) controlling the holding temperature for hot rolling at 580 degrees centigrade, for holding the metal for 2 hours; (3) hot rolling with an initial rolling temperature of 520 degrees centigrade and a finish rolling temperature of 320 degrees centigrade, to obtain a finishing rolled blank with a thickness of 4.2mm;

25

(4) subjecting the hot rolled blank to a secondary rolling to a intermediate thickness of 2.0mm; (5) interannealing the 2.0mm blank at a temperature of 450 degrees centigrade, with holding the metal for 2 hours; and (6) subjecting the blank to three times of further rolling to an article thickness of 0.27mm.

Example 2

30

[0037] An aluminium alloy strip according to the present invention was produced according to the process illustrated below, referring to the example formulation as shown in Table 1:

35

(1) providing materials of: 104000kg of 99.7 aluminium ingot (containing 52kg of Si, 198kg of Fe, 1.5kg of Mg), 156kg of AlSi20 alloy, 220kg of 80Fe agent, 102kg of Mg ingot, and 8.3kg of AlCu50 alloy; adding into a remelting furnace having a remelting temperature of 750 degrees centigrade, refining, inclusion removing, stirring, and analyzing and regulating the components, the composition listed in Table 1, adding into a stewing furnace, stewing, refining, degassing, inclusion removing, adding Al-5Ti-1B wires (1.2 ~ 1.4kg/t molten aluminium) and casting into a cast ingot in a casting machine at a casting temperature of 705 degrees centigrade;

40

(2) controlling the holding temperature for hot rolling at 550 degrees centigrade, for holding the metal for 2 hours; (3) hot rolling with an initial rolling temperature of 500 degrees centigrade and a finish rolling temperature of 320 degrees centigrade, to obtain a finishing rolled blank with a thickness of 4.2mm; (4) subjecting the hot rolled blank to a further rolling to an intermediate thickness of 2.0mm; (5) interannealing the 2.0mm blank at a temperature of 420 degrees centigrade, with holding the metal for 2 hours; and (6) subjecting the blank to three times of further rolling to an article thickness of 0.27mm.

45

Example 3

[0038] An aluminium alloy strip according to the present invention was produced according to the process illustrated below, referring to the example formulation as shown in Table 1:

50

(1) providing materials of: 116000kg of 99.7 aluminium ingot (containing 58kg of Si, 224kg of Fe, 1.2kg of Mg, 1.6kg of Cu), 116kg of AlSi20 alloy, 184kg of 80Fe agent, 91.6kg of Mg ingot, and 15.3kg of AlCu50 alloy; adding into a remelting furnace having a remelting temperature of 770 degrees centigrade, refining, inclusion removing, stirring, and analyzing and regulating the components, the composition listed in Table 1, adding into a stewing furnace, stewing, refining, degassing, inclusion removing, adding Al-5Ti-1B wires (1.2 ~ 1.4kg/t molten aluminium) and casting into a cast ingot in a casting machine at a casting temperature of 720 degrees centigrade;

55

(2) controlling the holding temperature for hot rolling at 520 degrees centigrade, for holding the metal for 4 hours; (3) hot rolling with an initial rolling temperature of 480 degrees centigrade and a finish rolling temperature of 320 degrees centigrade, to obtain a finishing rolled blank with a thickness of 4.5mm;

EP 3 159 421 A1

- (4)subjecting the hot rolled blank to a further rolling to a intermediate thickness of 2.2mm;
- (5) interannealing the 2.2mm blank at a temperature of 390 degrees centigrade, with holding the metal for 4 hours; and
- (6) subjecting the blank to three times of further rolling to an article thickness of 0.27mm.

5 Example 4

[0039] An aluminium alloy strip according to the present invention was produced according to the process illustrated below, referring to the example formulation as shown in Table 1:

- (1) providing materials of: 110000kg of 99.7 aluminium ingot (containing 53kg of Si, 208kg of Fe, 0.7kg of Mg, 0.6kg of Cu), 175kg of AlSi20 alloy, 235kg of 80Fe agent, 98kg of Mg ingot, and 20.5kg of AlCu50 alloy; adding into a remelting furnace having a remelting temperature of 770 degrees centigrade, refining, inclusion removing, stirring, and analyzing and regulating the components, the composition listed in Table 1,adding into a stewing furnace, stewing, refining, degassing, inclusion removing, adding Al-5Ti-1B wires (1.2 ~ 1.4kg/t molten aluminium) and casting into a cast ingot in a casting machine at a casting temperature of 720 degrees centigrade;
- (2) controlling the holding temperature for hot rolling at 520 degrees centigrade, for holding the metal for 6 hours;
- (3) hot rolling with an initial rolling temperature of 480 degrees centigrade and a finish rolling temperature of 320 degrees centigrade, to obtain a finishing rolled blank with a thickness of 4.5mm;
- (4)subjecting the hot rolled blank to a further rolling to a intermediate thickness of 2.2mm;
- (5) interannealing the 2.2mm blank at a temperature of 360 degrees centigrade, with holding the metal for 6 hours; and
- (6) subjecting the blank to three times of further rolling to an article thickness of 0.27mm.

Example 5

[0040] An aluminium alloy strip according to the present invention was produced according to the process illustrated below, referring to the example formulation as shown in Table 1:

- (1) providing materials of: 108000kg of 99.7 aluminium ingot (containing 42kg of Si, 198kg of Fe, 1.7kg of Mg, 0.6kg of Cu), 276kg of AlSi20 alloy, 238kg of 80Fe agent, 127kg of Mg ingot, 18.2kg of AlCu50 alloy, and 73kg of AlTi20 alloy; adding into a remelting furnace having a remelting temperature of 770 degrees centigrade, refining, inclusion removing, stirring, and analyzing and regulating the components, the composition listed in Table 1,adding into a stewing furnace, stewing, refining, degassing, inclusion removing, adding Al-5Ti-1B wires (1.2 ~ 1.4kg/t molten aluminium) and casting into a cast ingot in a casting machine at a casting temperature of 720 degrees centigrade;
- (2) controlling the holding temperature for hot rolling at 520 degrees centigrade, for holding the metal for 8 hours;
- (3) hot rolling with an initial rolling temperature of 480 degrees centigrade and a finish rolling temperature of 320 degrees centigrade, to obtain a finishing rolled blank with a thickness of 4.5mm;
- (4)subjecting the hot rolled blank to a further rolling to a intermediate thickness of 2.5mm;
- (5) interannealing the 2.5mm blank at a temperature of 380 degrees centigrade, with holding the metal for 8 hours; and
- (6) subjecting the blank to three times of further rolling to an article thickness of 0.27mm.

Table 1:

Ex.	Si	Fe	Mg	Ti	Cu	Any one of the other impurities	Al
1	0.04	0.35	0.06	0.015	0.004	<0.03	balance
2	0.08	0.36	0.10	0.015	0.004	<0.03	balance
3	0.07	0.32	0.08	0.015	0.008	<0.03	balance
4	0.08	0.36	0.09	0.012	0.01	<0.03	balance
5	0.09	0.36	0.12	0.020	0.009	<0.03	balance

Example 6

[0041] The aluminium strips obtained from examples 1 to 5 were analyzed for the grained texture (analysis of roughness). The product of the invention was tailed to 500mmx the width of the aluminium web, and measured for the roughness in an direction perpendicular to the rolling direction using the Hommel Tester W55 roughometer, and calculated the

EP 3 159 421 A1

average value of a plurality of measured values.

[0042] With testing experiments, the products according to the present invention showed results as listed in Table 2 below:

Table 2:

Sample	Ra (um)	Rz (um)	Rsk	Rku	Rpk (um)	Rk (um)	Rvk (um)
1050	0.23	2.21	0.60	3.40	0.39	0.70	-0.18
Ex.1	0.19	1.51	0.45	3.01	0.33	0.64	-0.17
Ex.2	0.19	1.24	0.57	3.05	0.38	0.68	-0.18
Ex.3	0.20	1.60	0.55	2.98	0.34	0.62	-0.15
Ex.4	0.17	1.35	0.49	3.12	0.34	0.69	-0.17
Ex.5	0.18	1.58	0.60	2.99	0.37	0.69	-0.16

Example 7:

[0043] The aluminium alloy strips obtained from examples 1-5 were compared with the control alloy strip prepared from the 1050 alloy from prior art for the grained images, using SEM and interferometer.

[0044] The test conditions comprised: electrolytically graining the product obtained according to the present invention and the 1050 alloy from prior art with various electrolytic parameters, simulating line speeds of 50m/min, 60m/min, 70m/min, and 80m/min, respectively, to provide various surfaces with different grains, where the experimental results at SEM * 250 were showed in Fig.5. Another test condition comprised: providing electrolytically grained surfaces with the same process above, except for SEM * 1000, where the experimental result were showed in Fig.6.

[0045] It can be seen clearly that under the test conditions simulating line speeds of 50 and 60m/minute, the strip according to the present invention had less flattops, deeper extent of graining, and more structure details, compared with the control 1050 alloy.

[0046] The MPA and MPD results from analyzing the grained images were summarized in Table 3 below:

Table 3

Sample	Testing condition	Graining area (um ²)		Graining depth (um)	
		Median	Standard Deviation	Median	Standard Deviation
1050	50m/min	26.6	41.2	1.87	0.52
Ex.1		24.2	37.7	1.88	0.45
Ex.2		25.5	39.3	1.67	0.49
Ex.3		25.0	39.6	1.72	0.48
Ex.4		26.1	40.6	1.77	0.43
Ex.5		24.8	36.2	1.83	0.47
1050	60m/min	22.1	46.0	2.08	0.42
Ex.1		20.2	32.9	1.94	0.37
Ex.2		23.2	36.4	1.95	0.44
Ex.3		20.9	35.5	1.94	0.43
Ex.4		20.4	35.9	1.72	0.48
Ex.5		21.3	37.2	1.78	0.45

EP 3 159 421 A1

(continued)

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Sample	Testing condition	Graining area (um ²)		Graining depth (um)	
		Median	Standard Deviation	Median	Standard Deviation
1050	70m/min	33.9	59.8	2.50	0.59
Ex.1		28.3	51.5	2.17	0.49
Ex.2		27.3	50.3	2.02	0.45
Ex.3		27.5	46.9	2.06	0.45
Ex.4		26.8	47.4	1.97	0.42
Ex.5		28.1	48.6	2.10	0.46
1050	80m/min	52.5	70.1	3.06	0.82
Ex.1		45.4	63.6	2.41	0.73
Ex.2		44.3	60.7	2.66	0.77
Ex.3		43.9	61.4	2.52	0.74
Ex.4		43.6	61.8	2.73	0.71
Ex.5		44.4	62.6	2.67	0.75

Example 8:

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[0047] The aluminium alloy strips obtained from examples 1-5 were compared with the control alloy strip prepared from the 1050 alloy from prior art for etching in electrolyte, using SEM and interferometer. The product obtained according to the present invention and the 1050 alloy from prior art were immersed into a 34g/L NaOH solution, washed with tap water and added with 15g/l (HCl) + 15g/l (SO4²⁻) solution for etching.

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[0048] The test condition comprised: corrosion etching after 5 seconds of deoiling treatment, SEM * 40, experimental result being showed in Fig.7. Another test condition comprised: corrosion etching after 5 seconds of deoiling treatment, SEM * 250: experimental results being showed in Fig.8.

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[0049] The images at different magnifications in Figs.7 and 8 showed, the product obtained according to the present invention had less etched points and relatively lighter etched channels on the surface, compared with the 1050 alloy from prior art.

Example 9:

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[0050] The aluminium alloy strips obtained from examples 1-5 were compared with the control alloy strip prepared from the 1050 alloy from prior art for open circuit potential (OCP). The product obtained according to the present invention and the 1050 alloy product were placed in an electrolyte for etching, and measured the open circuit potential and etching potential difference through the polarization curve.

[0051] The results were showed in Table 4 below:

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Table 4

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Sample	OCP		Median
AA1050	A	-0.68	-0.69
	B	-0.70	
Ex.1	A	-0.67	-0.67
	B	-0.67	
Ex.2	A	-0.69	-0.68
	B	-0.68	
Ex.3	A	-0.66	-0.67
	B	-0.68	

EP 3 159 421 A1

(continued)

Sample	OCP		Median
Ex.4	A	-0.65	-0.65
	B	-0.66	
Ex.5	A	-0.66	-0.66
	B	-0.67	

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Example 10:

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[0052] The aluminium alloy strips obtained from examples 1-5 were compared with the control alloy strip prepared from the 1050 alloy from prior art for mechanical properties. The tensile property and the crack resistance were tested using an electronic universal tensile testing machine and cold bending test. The unbaked mechanical properties were tested according to GB/T 228-2002 at room temperature, and the baked properties were tested according to the GB method after baking the sample at 240 degrees centigrade * 10min and cooling the same; while the cold bending test was carried out according To GB/T 15825.2-2008 at room temperature.

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[0053] The results were showed in Tables 5 and 6 below:

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Table 5: tensile properties: baked and unbaked

Sample	Form	Length	Thickness	Width	Yield Strength	Standard Deviation	Tensile Strength	Standard Deviation	Elongation	Standard Deviation
		mm	mm	mm	MPa		MPa		%	
1050	Unbaked	50	0.27	12.55	142	3.7	165	2.0	1.7	0.23
	Baked	50	0.27	12.54	121	5.6	149	1.9	2.4	0.14
Ex.1	Unbaked	50	0.27	12.53	189	2.5	196	1.5	4.2	0.19
	Baked	50	0.27	12.54	168	2.2	175	1.7	3.3	0.16
Ex.2	Unbaked	50	0.27	12.55	186	2.5	192	1.9	3.9	0.20
	Baked	50	0.27	12.55	166	2.3	172	1.8	3.0	0.19
Ex.3	Unbaked	50	0.27	12.53	185	2.4	190	2.1	4.5	0.19
	Baked	50	0.27	12.55	164	2.4	171	2.0	3.3	0.19
Ex.4	Unbaked	50	0.27	12.54	181	2.7	189	1.6	4.2	0.18
	Baked	50	0.27	12.54	160	2.6	169	1.8	3.1	0.16
Ex.5	Unbaked	50	0.27	12.55	182	2.6	191	1.6	3.7	0.19
	Baked	50	0.27	12.54	163	2.6	170	1.7	3.2	0.18

EP 3 159 421 A1

Table 6: crack resistance

Sample	Testing direction	Test 1	Test 2	Test 3	Test 4	Test 5	Cyclic median	Standard Deviation
1050	longitudinal	6568	6321	6111	6520	5881	6063	1066
	transverse	5124	5493	5055	5556	5085	5493	666
Ex.1	longitudinal	8445	8252	8294	8383	8409	8251	600
	transverse	7403	7411	7158	7268	7352	7277	388
Ex.2	longitudinal	8555	8358	8299	8634	8640	8379	663
	transverse	7676	7915	7842	7776	7993	7705	419
Ex.3	longitudinal	8561	8441	8396	8787	8702	8533	672
	transverse	7468	7502	7532	7661	7580	7466	408
Ex.4	longitudinal	8609	8477	8692	8699	8543	8605	647
	transverse	7556	7638	7458	7705	7691	7573	442
Ex.5	longitudinal	8809	8792	8715	8268	8544	8641	694
	transverse	7374	7706	7519	7688	7551	7536	462

Example 11:

[0054] The aluminium alloy strips obtained from examples 1-5 were compared with the control alloy strip prepared from the 1050 alloy from prior art for deoiling ability. A unit area of the product obtained according to the present invention and that of the 1050 alloy product were weighed, placed into a sodium hydroxide emulsion for etching, taken out, then rinsed with water, dried and weighed. The weight loss in a unit period was calculated. The testing conditions comprised: a clean surface of the sample being required, the etching solution being 34g/l NaOH at 70 degrees centigrade, and etching period of 5 seconds.

[0055] The results were showed in Table 7 below:

Table 7

Sample	No.	Weight before deoiling (g)	Weight after deoiling (g)	Δ (g/dm ²)	Δ (g/dm ²)	Δ Median (g/dm ²)	Standard derivation	Standard derivation%
1050	1	7.3500	7.3197	0.0151	1.51	1.48	0.05	3.1
	2	7.3498	7.3208	0.0145	1.45			
Ex.1	3	7.5265	7.4935	0.0165	1.65	1.66	0.01	0.85
	4	7.4998	7.4664	0.0167	1.67			
Ex.2	5	7.5502	7.5170	0.0166	1.66	1.67	0.01	0.94
	6	7.5499	7.5163	0.0168	1.68			
Ex.3	7	7.5156	7.4818	0.0169	1.69	1.67	0.03	0.99
	8	7.5151	7.4823	0.0164	1.64			
Ex.4	9	7.4999	7.4665	0.0167	1.67	1.67	0.02	0.95
	10	7.4998	7.4666	0.0166	1.66			
Ex.5	11	7.5067	7.4731	0.0168	1.68	1.68	0.02	0.96
	12	7.5059	7.4723	0.0168	1.68			

Claims

1. An aluminium alloy, comprising Al, Si, Fe, Mg, Cu, Ti and optionally other impurities, **characterized in that** the components are comprised in amounts by weight of: Si: 0.04-0.1%, Fe: 0.2-0.4%, Mg: 0.055-0.12%, Cu: 0.004-0.01%, Ti: 0.003-0.02%; any one of the other impurities is in an amount by weight of no more than 0.03%; and the balance is Al.
2. The aluminium alloy according to claim 1, **characterized in that** $Mg/Fe \geq 0.125$.
3. The aluminium alloy according to claim 1, **characterized in that** Mg is comprised in an amount of not less than 0.06%, preferably not less than 0.07%; and/or Mg is comprised in an amount of not more than 0.11%, preferably not more than 0.10%.
4. The aluminium alloy according to claim 1, **characterized in that** Cu is comprised in an amount of not less than 0.0045%, preferably not less than 0.005%; and/or Cu is comprised in an amount of not more than 0.009%, preferably not more than 0.008%.
5. The aluminium alloy according to claim 1, **characterized in that** Ti is comprised in an amount of not less than 0.004%, preferably not less than 0.005%; and/or Ti is comprised in an amount of not more than 0.019%, preferably not more than 0.017%.
6. The aluminium alloy according to claim 1, **characterized in that** the impurities comprise Li, Na, Pb, Be, Zn and/or V.
7. The aluminium alloy according to claim 1, **characterized in that** the total amount of the impurities is at most 0.1 wt%.
8. The aluminium alloy according to claim 1, **characterized in that** Al is comprised in an amount of not less than 99.30%.
9. An article comprising the aluminium alloy according to claim 1.
10. The article according to claim 9, **characterized in** being in the form of strip, foil or sheet.
11. The article according to claim 10, **characterized in that** the aluminium sheet/strip/foil has a thickness of about 0.14mm to about 0.5mm, preferably about 0.18mm to about 0.38mm.
12. The article according to claim 9 or 10, **characterized in** having a tensile strength of about 175 to about 210MPa, a yield strength of about 170 to about 200MPa, and/or an elongation of about 2% to about 6%, at room temperature; and **in that** through a simulated baking condition treatment at a temperature of 240 degrees centigrade for 10 minutes, the aluminium alloy article, after cooling, has a tensile strength of about 145 to about 170MPa, a yield strength of about 135 to about 155MPa, and/or an elongation of about 3% to about 8%.
13. Use of the article according to claim 9 or 10 for computer-to-plate.
14. A process of producing an aluminium alloy sheet/strip/foil for printing plate using the alloy according to claim 1, **characterized in** comprising the steps of:
 - 1) adding the alloy components as defined in claim 1 into a remelting furnace, melting, refining, inclusion removing, degassing and filtering, followed by casting into a sheet ingot with a thickness of about 500 to about 650 mm;
 - 2) sawing the head and butt of the sheet ingot, scalping, and then heating to a temperature of about 500 to about 600 degrees centigrade for about 2 to about 12 hours; and hot rolling the sheet ingot into a strip with a thickness of about 2.0 to about 5.0 mm at a temperature of about 250 to about 320 degrees centigrade;
 - 3) cold rolling the strip to a thickness of about 1 to about 3 mm, wherein the roll has a roughness, Ra, of about 0.30 to about 0.80 μm ;
 - 4) annealing the cold rolled strip from step 3) in an annealing furnace at a temperature of about 350 to about 450 degrees centigrade, and holding the temperature for about 2 to about 4 hours;
 - 5) continuing rolling the strip from step 4) on a cold roller to a thickness of about 0.14 to about 0.4 mm, with a Ra of about 0.15 to about 0.30 μm ; and
 - 6) cleaning the strip from step 5), edge trimming, and tension leveling, to obtain the aluminium alloy sheet, strip or foil.

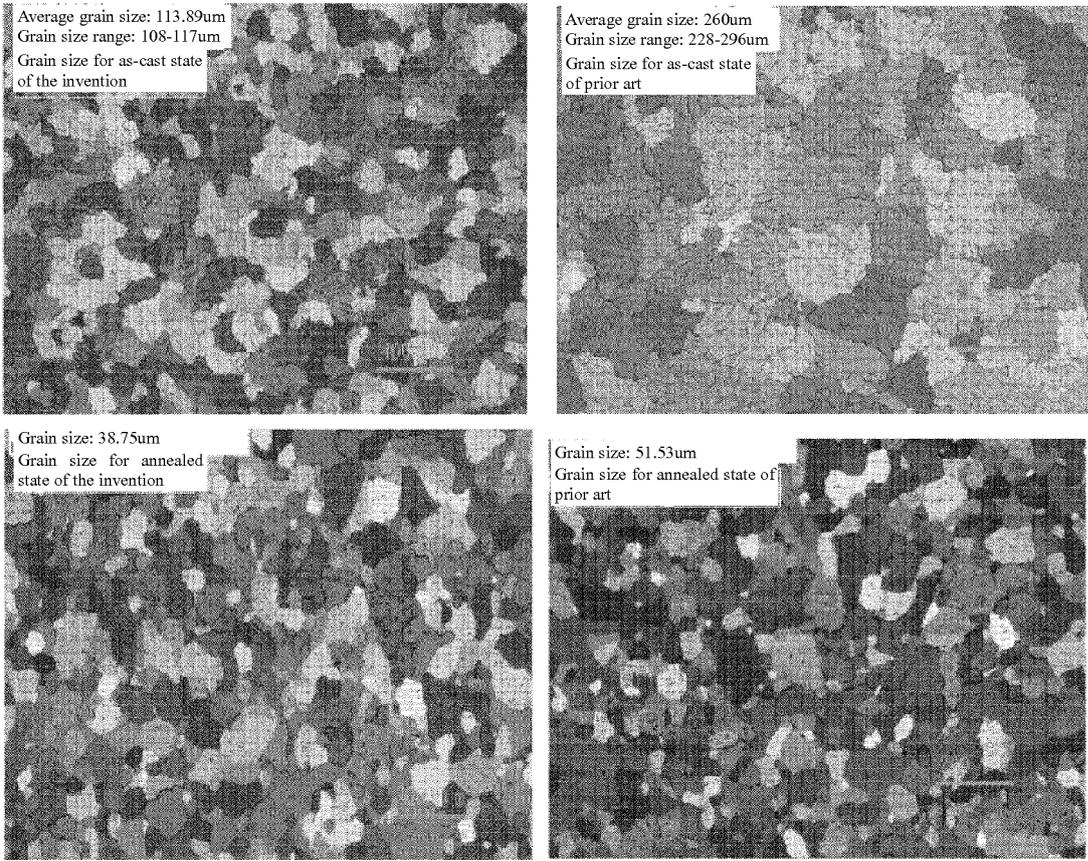


Fig. 1

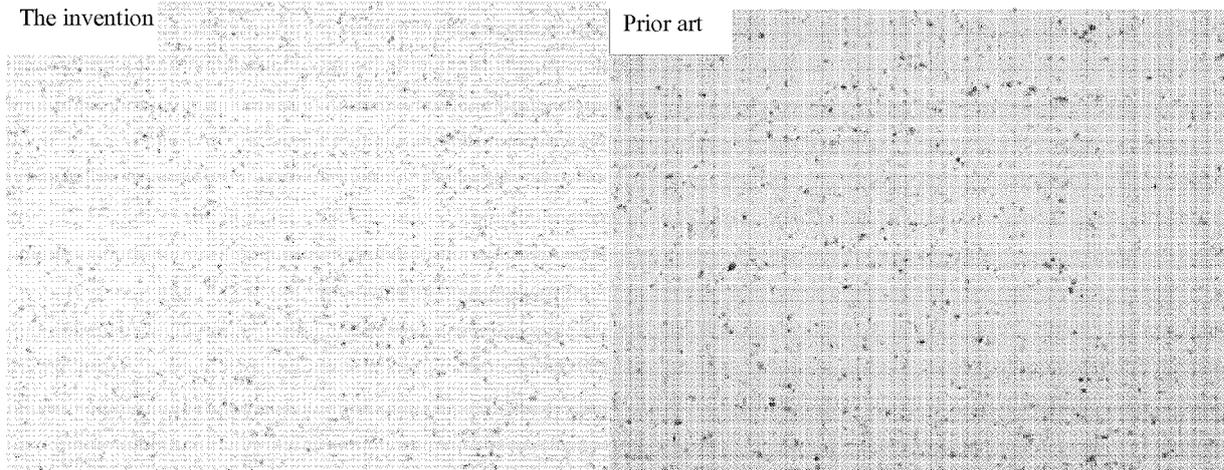


Fig. 2

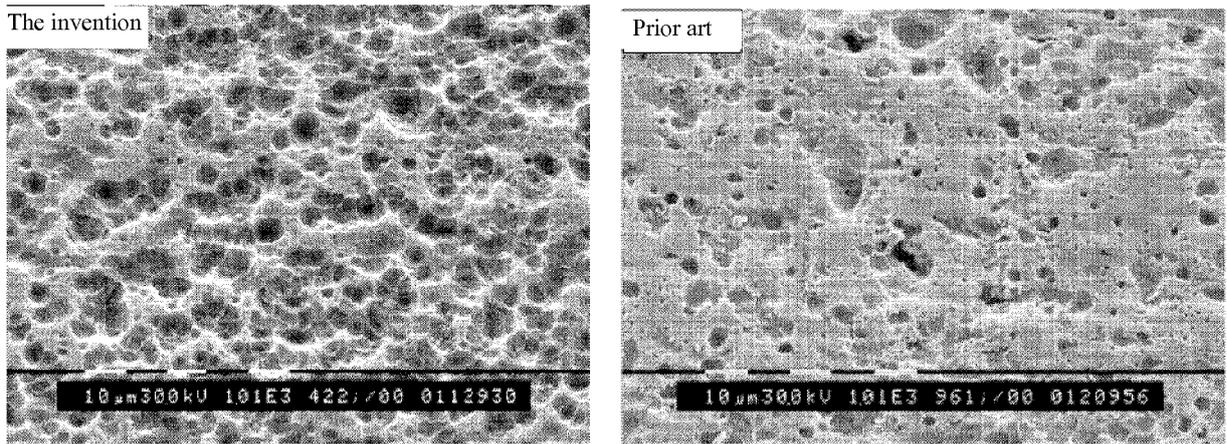


Fig. 3

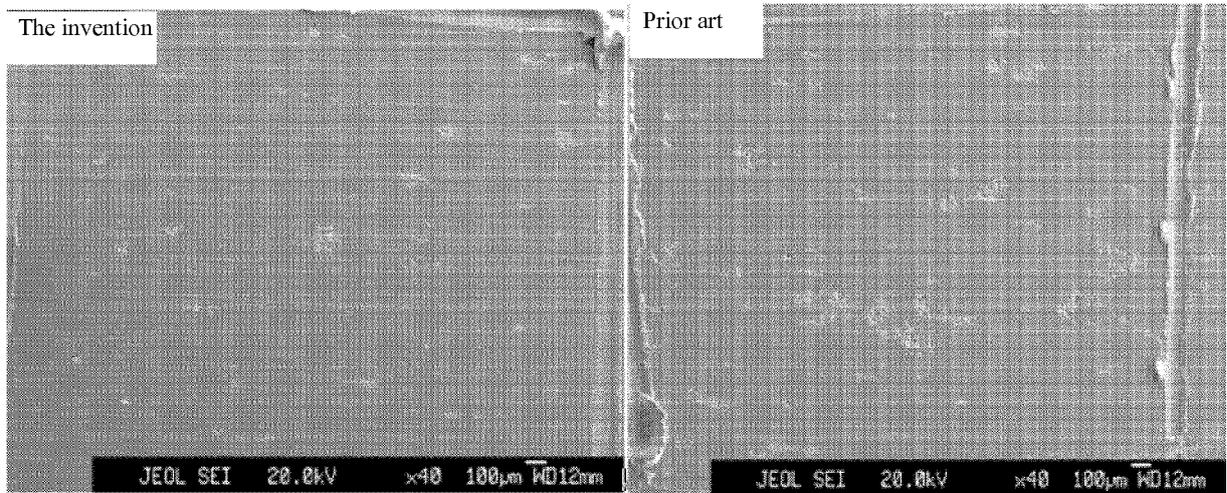


Fig. 4

SEM*250, line speed of 50m/min, 60m/min, 70m/min, and 80m/min, respectively

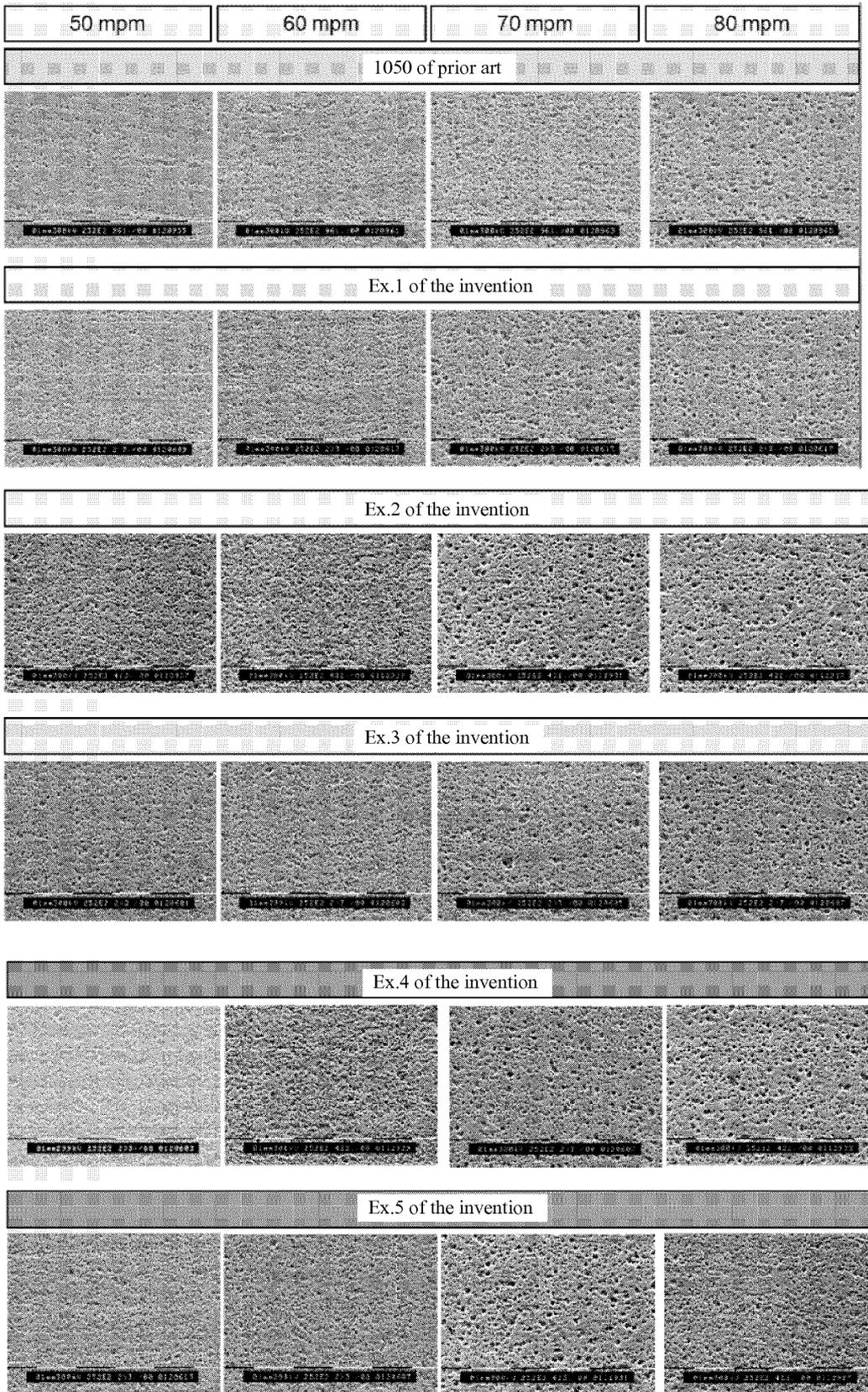


Fig. 5

SEM*1000, line speed of 50m/min, 60m/min, 70m/min, and 80m/min, respectively

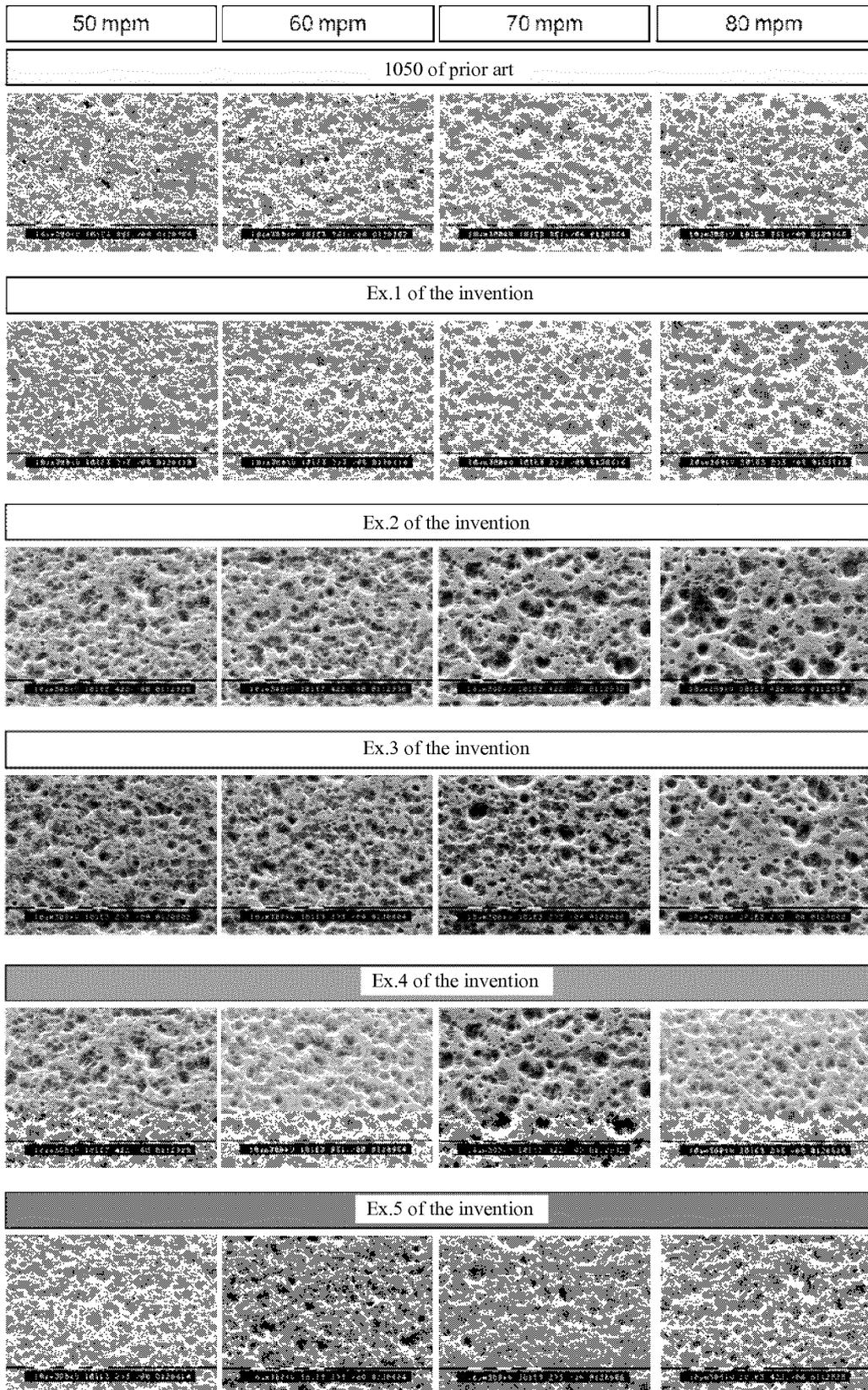


Fig. 6

Corrosion etches after 5 s of deoiling, SEM*40

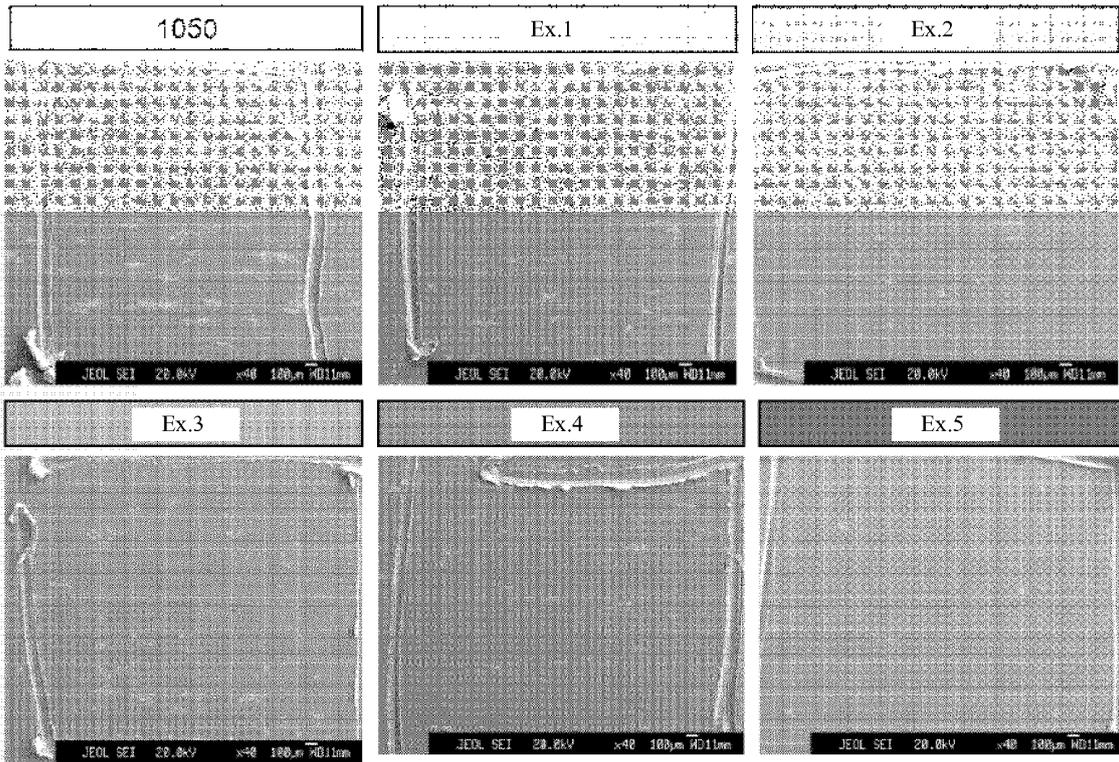


Fig. 7

Corrosion etches after 5 s of deoiling, SEM*250

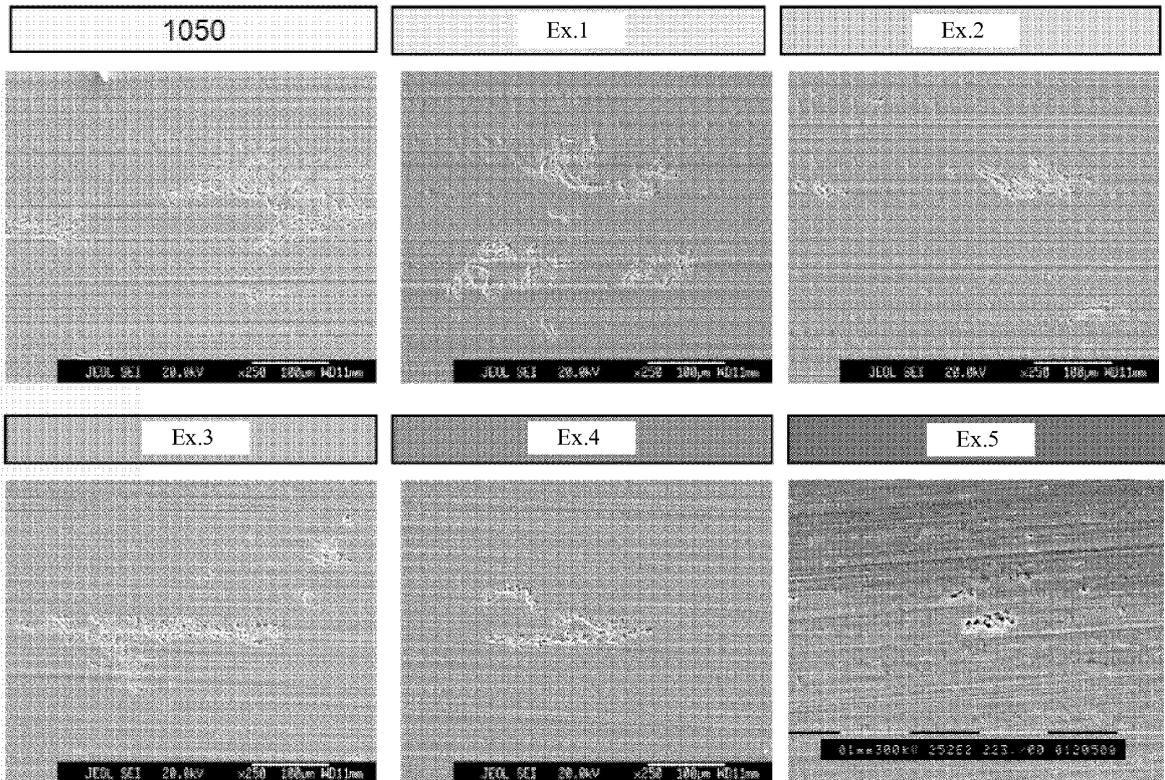


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2014/084268

A. CLASSIFICATION OF SUBJECT MATTER		
C22C 21/00 (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)		
IPC: C22C 21		
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)		
WPI, EPODOC, CNTXT, CNKI: alumin?um alloy, print+, rough+, cu, copper, ti, titanium, mg, magnesium		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
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"A" document defining the general state of the art which is not considered to be of particular relevance	"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	
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Date of the actual completion of the international search	Date of mailing of the international search report	
08 January 2015	13 March 2015	
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer WANG, Yu Telephone No. (86-10) 62084745	

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EP 3 159 421 A1

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Information on patent family members

International application No.
PCT/CN2014/084268

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