(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 138 592 A2**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.12.2009 Bulletin 2009/53

(51) Int Cl.:
C22C 21/00 $^{(2006.01)}$ ***C22F 1/04*** $^{(2006.01)}$
B41N 1/08 $^{(2006.01)}$

(21) Application number: **09251641.8**

(22) Date of filing: **24.06.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR

(30) Priority: **24.06.2008 GB 0811534**

(71) Applicant: **Bridgnorth Aluminium Ltd.**
Bridgnorth
Shropshire WV15 6AU (GB)

(72) Inventors:
- **Smith, Glenn Crosbie**
  Hagley DY9 0NZ (GB)
- **Flukes, Graham Alfred**
  Willenhall, West Midlands (GB)
- **Pickthall, Sarah Elizabeth**
  Edgmond, Shropshire TF10 8LQ (GB)

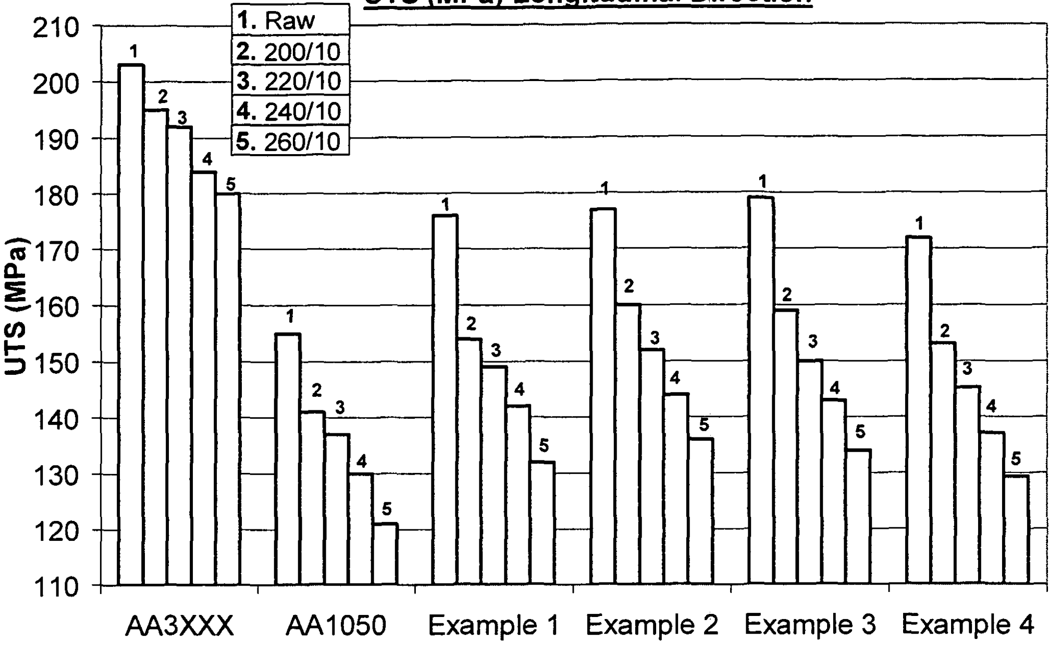
(74) Representative: **Johnstone, Helen Margaret**
Potter Clarkson LLP
Park View House
58 The Ropewalk
Nottingham
NG1 5DD (GB)

(54) Alloy

(57) An Al alloy suitable for processing into a lithographic sheet, the alloy having a composition in weight % of:
Fe 0.16 to 0.40
Si up to 0.25
Cu up to 0.01
Mn up to 0.05
Ti up to 0.015
Mg 0.02 to 0.10
Zn up to 0.06
unspecified other components up to 0.03 each
Al balance, wherein the minimum Al content is 99.3.

Figure 1

UTS (MPa) Longitudinal Direction



Printed by Jouve, 75001 PARIS (FR)

Description

[0001] This invention relates to an alloy suitable for processing into a lithographic sheet, to an alloy in the form of a thin rolled aluminium strip particularly for use by offset printing plate makers and to a method of processing such a lithographic sheet.

[0002] It is known that aluminium alloy in the form of a thin rolled aluminium strip is used by offset printing plate makers.

[0003] In order to process a thin rolled aluminium strip into a lithographic sheet, plate makers will initially degrease or etch the aluminium strip, typically in an alkaline solution. This process prepares the surface of the aluminium for graining, and evens out minor surface imperfections.

[0004] Electrograining is then carried out to create a surface topography with convoluted hemispherical pits. This is typically carried out in an electrolyte based on hydrochloric acid, or in one based on nitric acid.

[0005] Electrograining is carried out using an alternating current (AC) through an electrolytic cell containing the aluminium strip. The electro-chemical reactions that take place on each half cycle effectively remove aluminium from the surface by dissolution.

[0006] Alternatively, the surface of the aluminium strip may be mechanically roughened, for example by brushing. This process is, however, less common.

[0007] The function of the pits formed in the surface of the aluminium strip is to increase the surface area of the aluminium strip, and to hold water. In other words, due to the presence of the pits, the aluminium strip becomes hydrophilic.

[0008] A desmutting step may then be carried out in order to remove aluminium hydroxide smut created during the electrograining process.

[0009] Next, the aluminium strip is anodised. This results in the growth of a porous anodic oxide on the pitted surface of the aluminium strip. This provides a hard wearing coating which enhances the longevity of print quality of a lithographic sheet formed from the aluminium strip. It also enables better adhesion of the light-sensitive coating and makes the plate more chemically inert, thus improving its sheff-life.

[0010] Normally, a photosensitive polymeric coating is then applied to the aluminium strip. This coating repels water, but attracts oil. It is required that the lithographic sheet attracts oil, since printing ink is oil-based.

[0011] At this stage the lithographic plate comprises a hydrophilic anodised aluminium layer covered by an oleophilic photosensitive layer.

[0012] In its simplest form, an image is created by removing parts of the coating, for example by exposure to light. This means that the coating must be easy to remove to reveal the hydrophilic anodised layer beneath. However, the coating must also be hard-wearing in order to retain a well defined image during printing runs.

[0013] It is therefore important that the aluminium strip used to form the lithographic sheet has sufficient strength and appropriate surface functionality.

[0014] The term "surface functionality" is used to describe the ability of a material to electrograin well in order to provide a uniform distribution in size of pits without any surface streakiness or directionality being formed. This is important for the quality of the resulting printed images.

[0015] Most plate makers use an HCl based solution as the electrolyte during the electrograining process. However, it is also known to use an HNO_3 based electrolyte. The mechanism by which the graining process proceeds is different in each electrolyte. It is advantageous for a material to electrograin well in both electrolytes.

[0016] In the lithographic plate making industry, it is known in particular to use two alloy types. The first alloy type is known as AA1050 and has the composition set out in Table 1 below. AA1050 exhibits good electrograining behaviour.

[0017] If a material has "good electrograining behaviour" it means that the material has the ability to produce a uniformly pitted surface under a broad range of conditions. Such a material should also be capable of electrograining in either hydrochloric acid or nitric acid based electrolytes.

Table 1

Alloy	Fe%	Si%	Cu%	Mn%	Mg%	Zn%	Ti%	V%	Others %	Al%
AA1050	Up to 0.40	Up to 0.25	Up to 0.05	Up to 0.05	Up to 0.05	Up to 0.05	Up to 0.03	Up to 0.05	Up to 0.03	99.50 min
AA1050A	Up to 0.40	Up to 0.25	Up to 0.05	Up to 0.05	Up to 0.05	Up to 0.07	Up to 0.05	Not defined	Up to 0.03	99.50 min

[0018] A second alloy type is known as AA3XXX and comprises AA3103 or AA3003 alloys having the compositions set out in Tables 2 and 3 below. AA3XXX has improved strength when compared to the strength of AA1050. However the electrograining properties of AA3XXX are not as good as those of the AA1050 alloy type.

AA3103

[0019]

Table 2

Alloy	Fe%	Si%	Cu%	Mn%	Mg%	Zn%	Zr + Ti %	Cr%	Others %	Al%
AA3103	Up to 0.7	Up to 0.50	Up to 0.10	0.9 - 1.5	Up to 0.30	Up to 0.20	Up to 0.10	Up to 0.10	Up to 0.05 each, up to 0.15 total	Balance

AA3003

[0020]

Table 3

Alloy	Fe%	Si%	Cu%	Mn%	Mg%	Zn%	Ti%	Others	Al
AA3003	Up to 0.7	Up to 0.6	0.05-0.20	1.0-1.5	Not defined	Up to 0.10	Not defined	Up to 0.05% each, 0.15% total	Balance

[0021] The AA1050 alloy type is traditionally used in the European, Asian and South American markets. This alloy type electrograins well in both HCl and HNO_3 based solutions, but has a lower strength compared to other alloys. This is thought to be a potential problem in situations where alloys are to be used to form a lithographic sheet for use in longer print runs.

[0022] The AA3XXX alloy type is traditionally used in North America. It is more difficult to electrograin this alloy type and therefore it is more often used when mechanical roughening processes may be applied.

[0023] AA3XXX alloys can be electrograined in HCl but the electrograining process may produce surface streakiness. These alloys, thus, have relatively poor electrograining behaviour, but have a high raw strength and high bake strength.

[0024] The wear resistance of the photosensitive coating is often improved by baking the lithographic plate. This process may, however, have an adverse effect on the strength of the aluminium substrate. This practice is more common in North America, and tends to explain the increased use of A3XXX.

[0025] The bake strength of an alloy is typically measured using a standard bake test. The standard bake test involves heating the alloy for ten minutes at 240°C.

[0026] It is important that alloys to be used for processing into lithographic sheet do not soften significantly on baking, so that the strength of the alloy is not adversely affected. Significant softening and the associated microstructural changes to the aluminium alloy substrate could also have a negative impact on the dimensional properties of the printing plate. This may be detrimental with respect to failure by fatigue.

[0027] In general it has been found that an alloy exhibiting good electrograining behaviour may not have the required strength, whereas an alloy having the required strength may have poor electrograining behaviour.

[0028] According to a first aspect of the present invention there is provided an Al alloy suitable for processing into a lithographic sheet, the alloy having a composition in weight % of:

Fe 0.16 to 0.40
Si up to 0.25
Cu up to 0.01
Mn up to 0.05
Ti up to 0.015
Mg 0.02 to 0.10
Zn up to 0.06

unspecified other components up to 0.03 each
Al balance, wherein the minimum Al content is 99.3.

[0029] By having a high percentage of aluminium in the alloy, there is a correspondingly lower level of other components. This results in an alloy that is more versatile when recycling after use.

[0030] Preferably, the minimum aluminium content is 99.45 wt%. More preferably, the minimum aluminium content is 99.50 wt%.

[0031] By having a higher percentage weight of aluminium in the alloy, the versatility of the alloy is further increased when recycling after use.

[0032] Magnesium is used to improve the graining performance of the alloy, but has a limited influence on the strength of the alloy. Magnesium does however improve the mechanical properties (such as the strength) of both the raw and baked alloy and therefore its presence in the alloy is important. However limiting the range of magnesium to 0,10 wt% is important insofar as it does not compromise the versatility of the alloy for recycling purposes.

[0033] An alloy according to the present invention may contain up to 0.099 wt% magnesium.

[0034] Preferably, the magnesium content is within the range 0.02 to 0.05 wt%.

[0035] Zinc also improves the graining performance of the alloy but also has limited influence on the strength of the alloy. It has been found by the inventors that a weight percentage of up to 0.05 of zinc in the aluminium alloy can have beneficial effects in respect of the electrochemical properties of the alloy.

[0036] Advantageously, the minimum zinc content is 0.02 wt%.

[0037] The ratio of zinc to magnesium in the alloy may be substantially within the range 0.1 to 2.3.

[0038] It has been found that by controlling the zinc and magnesium content, it is possible for the resulting aluminium alloy to have good electrograining behaviour.

[0039] The presence of iron in the aluminium alloy serves two purposes. The first is to ensure the formation of iron rich intermetallics which are essential for the development of a homogeneous pit structure during the electrograining (roughening) step of the plate making process. The second is to ensure that there is sufficient iron in the solid solution within the material which is beneficial for good temperature stability properties, and particularly to strength retention after plate baking.

[0040] An advantage of the alloy having a minimum iron content is that it ensures that a sufficient number of 2nd phase intermetallics are present in the structure of the alloy. This in turn can only be achieved when the level of iron solubility in aluminium is exceeded.

[0041] Increasing the iron content of the alloy is advantageous because iron provides a hardening effect in aluminium alloys, thus increasing the strength of the alloy.

[0042] However, it is not advantageous to increase iron beyond the upper limit of 0.4 % because such further addition provides no further positive effect on the alloy structure and minimal further increase in strength. A further disadvantage of increasing the iron content beyond 0.4 wt% is that it compromises the versatility of the alloy for recycling purposes.

[0043] It has been found that the presence of copper in an aluminium alloy can affect the roughened pit morphology, but on the other hand can improve the material strength in both the raw and baked conditions. The inventors have found that if the weight percentage of copper is kept to 0.01 or less, the alloy can benefit from improved strength due to the presence of the copper, whilst at the same time the adverse effects of copper on the pit morphology are kept to a minimum.

[0044] The presence of titanium in an aluminium alloy is necessary to ensure adequate metallurgical grain size control. However, too much titanium can have an adverse effect on the electrochemical performance of the alloy. The inventors have found that if the weight percentage of titanium is no more than 0.015 the alloy can benefit from the grain size control effected by the titanium, but at the same time the adverse effects on the electrochemical performance are kept to a minimum.

[0045] An alloy according to the present invention may contain up to 0.049 wt% manganese.

[0046] Preferably, the minimum manganese content is 0.005 wt%.

[0047] The presence of manganese in the alloy serves to increase both the raw and baked strength of the alloy. However, the manganese may have a negative impact on the electrograining behaviour of the alloy and therefore the level of manganese in the alloy should not be too high.

[0048] Preferably, the manganese content falls within the range 0.005 to 0.030 wt%.

[0049] Advantageously, the manganese to magnesium ratio is substantially within the range 0.08 to 1.63.

[0050] According to a second aspect of the present invention, there is provided a lithographic sheet formed from an alloy according to the first aspect of the present invention.

[0051] According to a third aspect of the present invention, there is provided a method for processing a lithographic sheet formed from an alloy according to the first aspect of the present invention.

[0052] The invention will now be described by way of example only, with reference to the examples set out below.

[0053] Set out below are details of the composition of four examples of preferred embodiments of the invention showing the weight percentage of components forming the alloy.

Table 4

Alloy	Al	Fe	Si	Cu	Mn	Ti	Mg	Zn	Others
Example 1	99.48	0.36	0.08	0.001	0.009	0.006	0.046	0.022	0.005
Example 2	99.44	0.33	0.05	0.001	0.049	0.008	0.048	0.060	0.008
Example 3	99.39	0.35	0.06	0.001	0.049	0.009	0.080	0.053	0.007
Example 4	99.52	0.33	0.06	0.001	0.009	0.008	0.045	0.022	0.007

[0054] The invention will be further described by way of non-limiting example only with reference to the accompanying figures, in which:

Figure 1 is a graphical representation showing the ultimate tensile strength in the longitudinal direction of examples 1, 2, 3 and 4 identified above, in a raw, unbaked state and after having been baked at each of 200°C, 220°C, 240°C and 260°C for ten minutes, compared to known alloy groups AA3XXX and AA1050.

Figure 2 is a graphical representation showing the proof stress (R_p) in the longitudinal direction of examples 1, 2, 3 and 4 identified above, in a raw, unbaked state and after having been baked at each of 200°C, 220°C, 240°C and 260°C for ten minutes, compared to known alloy group AA1050.

Figure 3 is a graphical representation showing the ultimate tensile strength in the transverse direction of examples 1, 2, 3 and 4 identified above, in a raw, unbaked state and after having been baked at each of 200°C, 220°C, 240°C and 260°C for ten minutes, compared to known alloy group AA1050.

Figure 4 is a graphical representation showing the proof stress (R_p) in the transverse direction of examples 1, 2, 3 and 4 identified above, in a raw, unbaked state and after having been baked at each of 200°C, 220°C, 240°C and 260°C for ten minutes, compared to known alloy group AA1050.

Figures 5 and 5a are micrographs, each showing a cross section of a sample of an AA1050 alloy after undergoing a bend test. Figure 5 is at a magnification of x200 and Figure 5a is at a magnification of x100.

Figures 6 and 6a are micrographs, each showing a cross section of a sample of Example 1, identified above, after undergoing a bend test. Figure 6 is at a magnification of x200 and figure 6a is at a magnification of x100.

Figure 7 is a micrograph showing the outer bend surface in more detail of the sample of AA1050 shown in Figure 5; and is at a magnification of x112.5.

Figure 8 is a micrograph showing the outer bend surface in more detail of the sample of Example 1 shown in Figure 6. Figure 8 is at a magnification of x112.5.

[0055] The tensile strength, or ultimate tensile strength/stress (UTS) is the highest load applied to a material in the course of a tensile test, divided by the original cross-sectional area of the material. In brittle or tough materials it coincides with the point of fracture, but usually extension continues under a decreasing stress after the UTS has been passed.

[0056] The proof stress (R_p) is the stress required to produce a certain amount of permanent set (plastic deformation) in metals that do not exhibit a distinct yield point. In the attached Figures 2 and 4, proof stress is the stress producing a strain of 0.2% (R_p 0.2).

[0057] As mentioned above, the standard bake test is ten minutes at 240°C. In Figures 1 to 4, additional temperatures, namely 200, 220 and 260°C, are also examined in order to show the behaviour of strength of each alloy, and how it reduces with different bake conditions.

[0058] As shown in Figure 1, each of Examples 1 to 4 has a higher ultimate tensile strength in the longitudinal direction, both in the raw unbaked state and at the identified temperatures, when compared to the AA1050 group of alloys. The AA3XXX group of alloys does, however, have higher strength than the Examples 1 to 4.

[0059] Figure 2 shows that each of the Examples 1 to 4 has a higher proof stress in the longitudinal direction, both in the raw unbaked state and at the identified temperatures, than the AA1050 group of alloys.

[0060] Figure 3 shows that each of the Examples 1 to 4 has a higher ultimate tensile strength in the transverse direction, both in the raw unbaked state and at the indicated temperatures, than the AA1050 group of alloys.

[0061] Figure 4 shows that each of the Examples 1 to 4 has a higher proof stress in the transverse direction than the AA1050 group of alloys, both in the raw state and at the temperatures indicated.

[0062] Bend properties are perceived to be more important than strength in terms of press performance, but are not as straightforward to measure. Therefore, strength is often used as an approximate guideline. However, simple bending tests have been carried out on the identified examples.

[0063] The bend test used is a static test based on making and examining a bend which is used to fix a lithographic plate onto a printing press.

[0064] A static test is deemed to be most appropriate, as the nature of the material (for example the alloy composition, the temper, and the method of processing the alloy) has a significant impact on the initial bend, yet a limited impact on fatigue. It is understood that failure by fatigue is mostly determined by the bend dimensions and the material gauge.

[0065] In order to carry out bend tests, a plate formed from a particular alloy was bent to a strict set of parameters. If the dimensions vary too much from the designated values, including a specified gauge, then this could compromise the test results.

[0066] The thickness measurements of the samples were kept as constant as possible, ranging between 0.275 and 0.280 mm.

[0067] The inside bend radius and gauge largely determine the amount of strain on the outer surface of the bend. This can vary significantly with only a small change in set up parameters. Therefore, the inside bend radius is kept constant.

[0068] In use, the aluminium litho plate would be bent using a plate bender. A plate bender is associated with a printing press and is the piece of equipment that is used to form the bend. In this test, a simple bend of 60° around a set radius was made to simulate the plate bender. 60° is in the region of typically used bend angles.

[0069] The tests were carried out in two directions, with the bend axis parallel to, and perpendicular to, the rolling direction of the plate. The rolling direction is the direction in which the aluminium sheet is processed during rolling.

[0070] The tests were compared to tests carried out on the AA1050 group of alloys.

[0071] Once the tests had been carried out, a bend in an alloy was evaluated in terms of its cross sectional and outer surface appearance using optical microscopy.

[0072] Micrographs showing bend test data for a sample of a AA1050 alloy and for a sample of Example 1 as identified above are shown in Figures 5 to 8.

[0073] Figures 5 and 5a are micrographs showing a cross section of the sample of the AA1050 alloy after undergoing a bend test, as described above. It can be seen from these figures that there is inward distortion on the inner surface of the alloy caused by compressive deformation of the inner bend surface. This distortion is in the encircled area identified by the reference numeral 1. Compressive deformation can be gauged by the level of inward distortion.

[0074] It can also be seen that there are ridges formed on the outer surface of the alloy by shear deformation on the outer surface, as shown in area 2. The level of shear deformation can be gauged by the depth of the ridges formed.

[0075] It is believed to be an advantage for a material not to form deformation ridges. This is because it is thought that the ridges could behave as concentrators of stress and act as a weak point for the initiation of printing plate failure.

[0076] Figures 6 and 6a show a cross section of a sample of Example 1, as identified above, after undergoing a similar bend test. It can be seen from these figures that there is reduced inner bend deformation shown in area 3, and the outer surface is smoother as shown in area 4, when compared to the outer surface of the sample of AA1050 alloy shown in Figures 5 and 5a.

[0077] Figures 7 and 8 show in more detail the outer bend surface of the sample of AA1050 alloy and a sample of Example 1, respectively. Again it can be seen from Figure 7, in the encircled areas labelled with the reference numeral 5, that deep ridges exist in the sample of AA1050 alloy when compared to the sample of Example 1.

[0078] An analysis of micrographs such as those shown in Figures 5 to 8 is largely qualitative. Nevertheless the levels of shear deformation and cracking observed varied between different materials allowing for a straightforward comparison between the different alloys. Roughness measurements were also carried out on the outer surface of the bend for each alloy, and the maximum peak to trough distances of the shear deformation ridges on the outer surface of the bends were measured.

[0079] These topographical measurements of the outer bend surface were made using a white light interferometer. In this application interferometery is used as a non-contact method of measuring surface roughness.

[0080] The results of the roughness measurements are set out in Table 5 below.

Table 5

Variant	Maximum peak to trough distance (μm)
Example 1	13
Example 2	11
Example 3	16
Example 4	17
AA1050	19

[0081] A summary of the test results is set out below in Table 6. As can be seen from the table, the AA1050 group of alloys show moderate deformation during such bend tests. It is understood that the AA3XXX group of alloys show very little deformation in bending.

Table 6

Grade	**Level of deformation**	**Variant**
+	Small amount of deformation.	Example 1, Example 2
+-	Small to moderate amount of deformation.	Example 3, Example 4
-	Moderate deformation.	AA1050

[0082] As explained above, it is important that a uniformly pitted and streak free surface is achieved by electrograining the alloy in either a solution based on hydrochloric acid, or one based on nitric acid, to produce a surface having good functionality.

[0083] The electrograining performance of the Examples 1 to 4 compared to both the AA1050 and the AA3XXX group of alloys is set out below.

[0084] The results described below are based on laboratory testing of alloys in an HCl based electrolyte.

[0085] The following scale of measuring electrograining performance has been used.

Table 7

Grade	Electrograining	Comment
++	Very good	This is the target electrograining performance, with high uniformity and ease of initiation.
+	Good	This is the industry-accepted benchmark for electrograining performance.
+-	Adequate	This indicates a slight deterioration in uniformity, but is still considered acceptable.
-	Poor	This indicates a noticeable deterioration in uniformity and initiation. This would suggest that there could be problems on an industrial scale.
--	Very poor	This indicates poor performance, as incomplete electrograining would be seen on the laboratory scale.

[0086] The results for the different Examples are given below.

[0087] All conditions use a charge density of 1000 C/dm^2, but the electrograining is carried out for different lengths of time.

[0088] The "easy" laboratory condition is achieved by electrograining for 24 seconds.

[0089] The "intermediate" condition is achieved by electrograining for 9.5 seconds.

[0090] The "difficult" condition is achieved by electrograining for 6.5 seconds.

Table 8

Alloy	Easy electrograining condition	Intermediate electrograining condition	Difficult electrograining condition
AA1050	++	+	+
AA3xxx	--	--	--
Example 1	++	++	+
Example 2	++	++	++
Example 3	++	++	++
Example 4	++	++	+

[0091] The results show that each of the Examples 1 to 4 has electrograining properties at least as good as, and under certain conditions, better than the AA1050 group of alloys.

[0092] The electrograining behaviour of each of Examples 1 to 4 is, in all cases better than that of the AA3XXX alloy group.

[0093] The present invention therefore provides an aluminium alloy having improved strength compared to the AA1050 alloy type, and improved electrograining behaviour compared to the AA3XXX alloy type.

[0094] A process for forming a lithographic sheet according to the present invention will now be briefly described. The process may be viewed as three sub-processes; the production of alloy and slab casting; the production of thin rolled aluminium strip; and the production of a lithographic sheet. These processes will now be described in further detail.

Production of Alloy and Slab Casting

[0095] Rolling sheet ingot is made by DC (direct chill) casting of molten aluminium.

[0096] The elemental composition of the metal is controlled to the described levels by appropriate additions.

[0097] The ingots are typically between 400-650mm in thickness.

Production of Thin Rolled Aluminium Strip

[0098] Scalping of the rolling sheet ingot is carried out to improve surface cleanliness and uniformity by removing the casting skin. Up to 25mm in total is removed from both surfaces.

[0099] Pre-heating is carried out to achieve exit metal temperatures of 400-600°C for hot rolling.

[0100] The ingot is hot rolled in multiple passes to a plate gauge of between 11-18mm thick.

[0101] In-line quenching reduces the plate temperature to <50°C.

[0102] The plate is then cold rolled to an intermediate gauge.

[0103] Batch inter-annealing can be carried out. The target metal temperature is between 350-550°C.

[0104] Further cold rolling steps are used to achieve the final product thickness of between 0.1-0.5mm.

[0105] The coil can then be levelled and degreased before supply for the production of lithographic sheet.

Production of Lithogaphic Sheet

[0106] The surface is prepared for roughening by an alkaline-based etching process.

[0107] Roughening is preferably achieved by electrograining. This is carried out in an electrolyte based on hydrochloric acid, or an electrolyte based on nitric acid. An AC current is applied to the electrograining bath to achieve roughening.

[0108] The electrograined surface is anodised to improve wear resistance.

[0109] Various other in-line treatments may be applied to improve plate properties between some or each of the described basic process steps.

[0110] A photosensitive coating is applied.

[0111] After the plate has been imaged, it can be baked to improve the wear resistance of the photosensitive coating.

Claims

1. An Al alloy suitable for processing into a lithographic sheet, the alloy having a composition in weight % of:

   Fe 0.16 to 0.40
   Si up to 0.25
   Cu up to 0.01
   Mn up to 0.05
   Ti up to 0.015
   Mg 0.02 to 0.10
   Zn up to 0.06
   unspecified other components up to 0.03 each
   Al balance, wherein the minimum Al content is 99.3.

2. An alloy according to Claim 1 wherein the minimum aluminium (Al) content is 99.45 wt%.

3. An alloy according to Claim 1 or Claim 2 wherein the minimum aluminium content is 99.50 wt%.

4. An alloy according to any one of the preceding claims containing up to 0.099 wt% magnesium.

5. An alloy according to any one of the preceding claims wherein the magnesium content is preferably within the range 0.02 to 0.05 wt%.

6. An alloy according to any one of the preceding claims wherein the minimum zinc (Zn) content is 0.02 wt%.

7. An alloy according to any one of the preceding claims, wherein the ratio of zinc to magnesium in the alloy is substantially within the range 0.1 to 2.3.

8. An alloy according to any one of the preceding claims containing up to 0.049 wt% manganese.

9. An alloy according to any one of the preceding claims wherein the minimum manganese (Mn) content is 0.005 wt%.

10. An alloy according to any one of the preceding claims wherein the manganese (Mn) content falls within the range 0.005 to 0.030 wt%.

11. An alloy according to any one of the preceding claims wherein the manganese to magnesium ratio is substantially within the range 0.08 to 1.63.

12. A lithographic sheet formed from an alloy according to any one of the preceding claims.

13. A method of processing a lithographic sheet according to Claim 12.

Figure 1

UTS (MPa) Longitudinal Direction

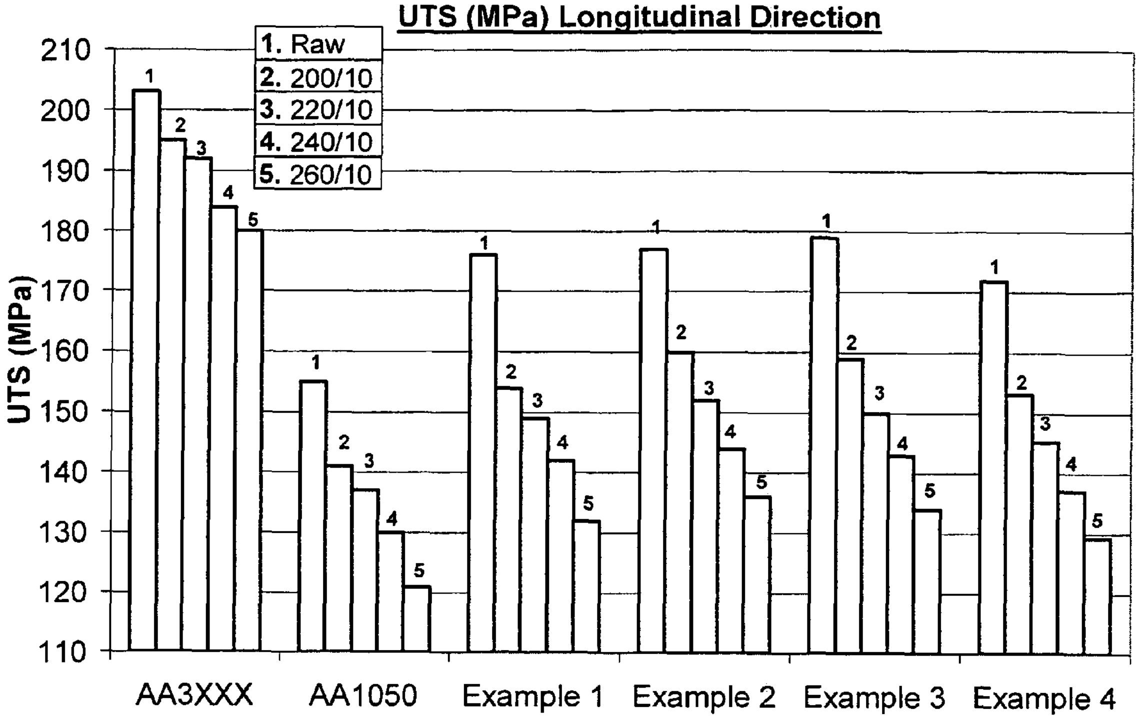


Figure 2

Rp 0.2 (MPa) Longitudinal Direction

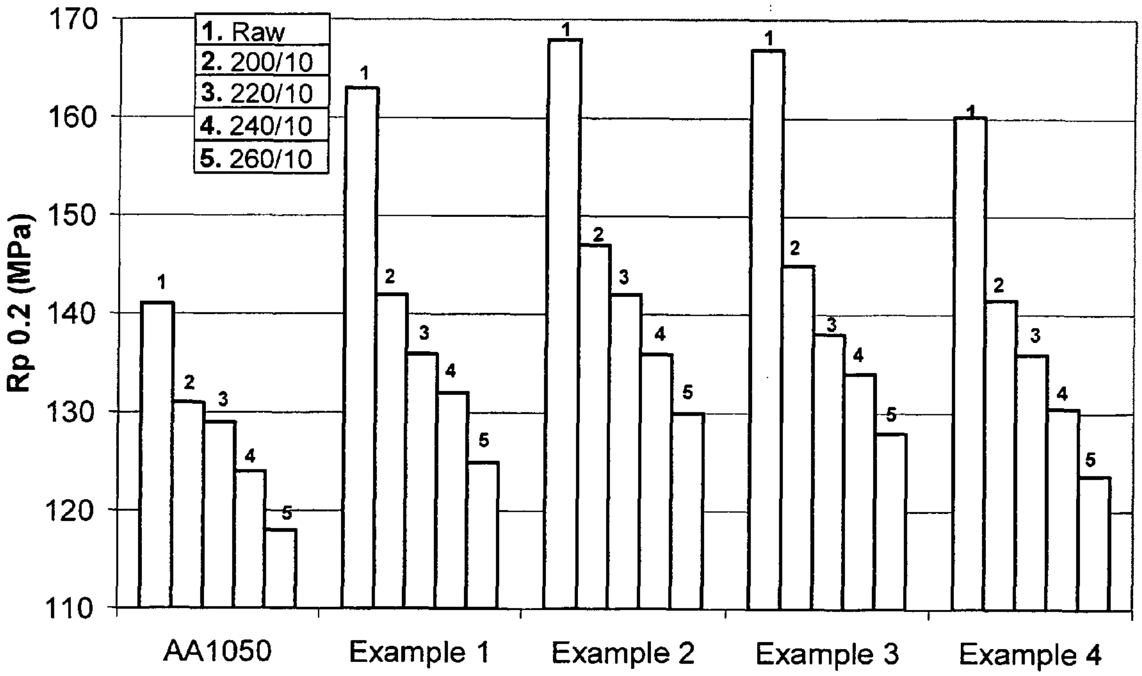


Figure 3

UTS (MPa) Transverse Direction

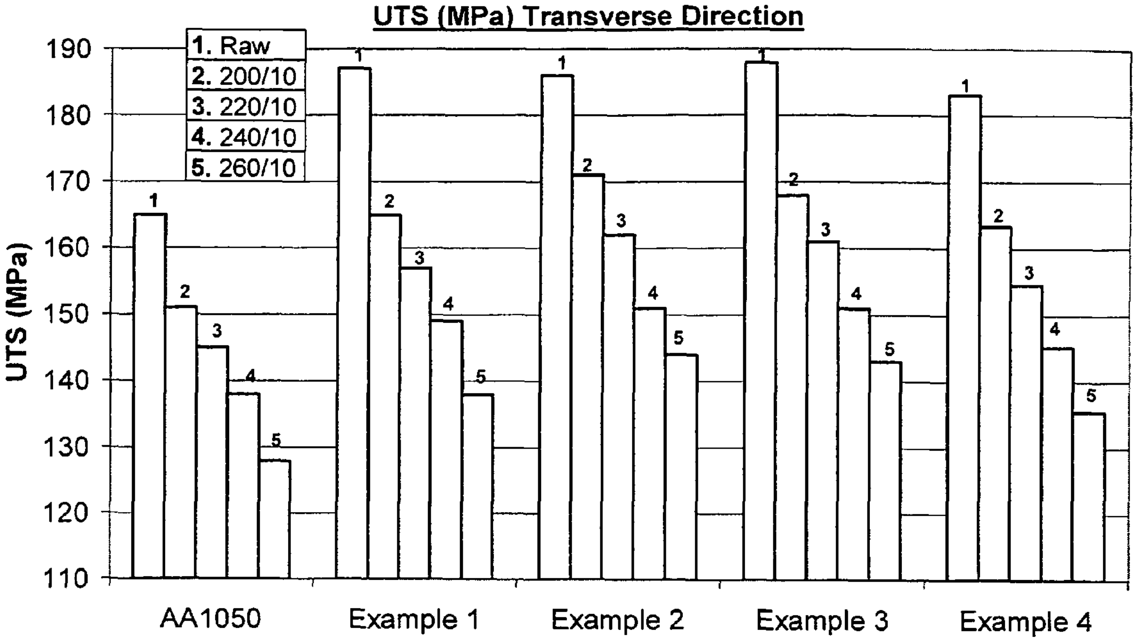
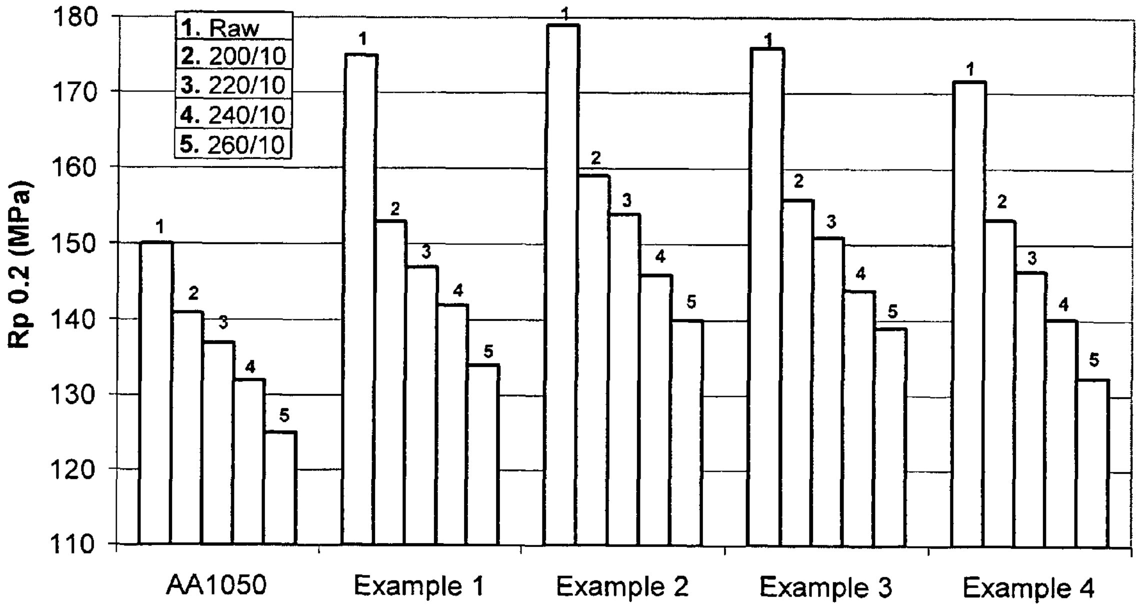


Figure 4

Rp 0.2 (MPa) Transverse Direction



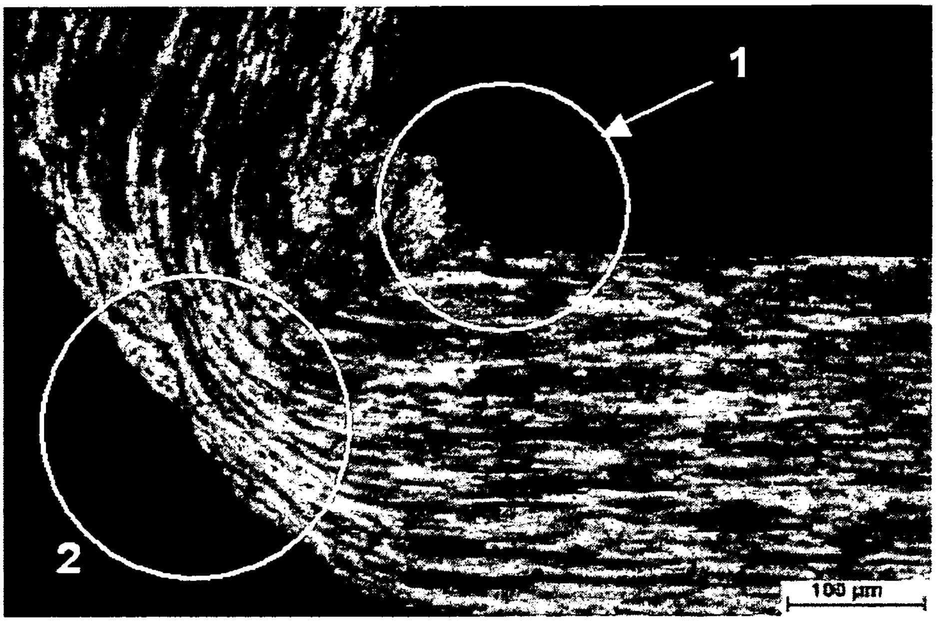


Figure 5

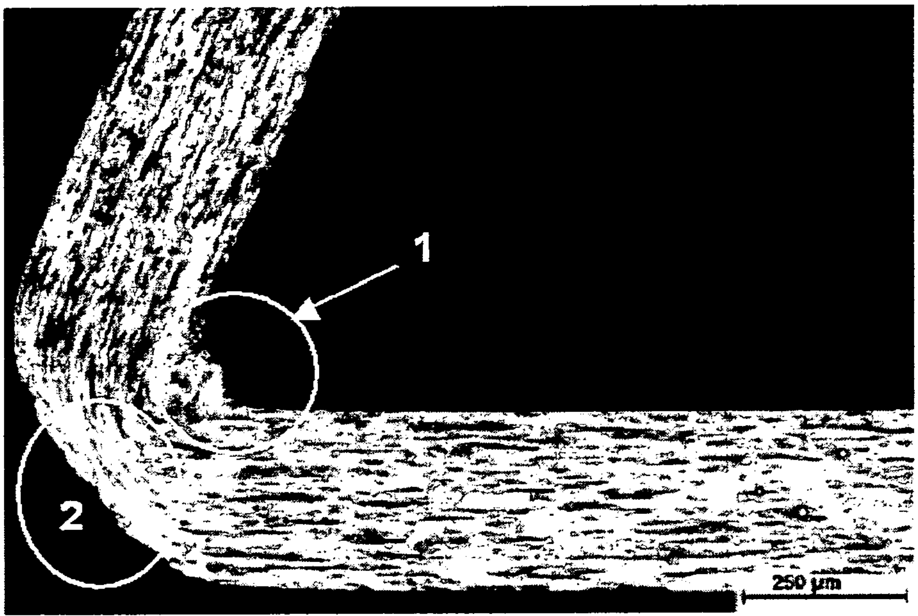


Figure 5a

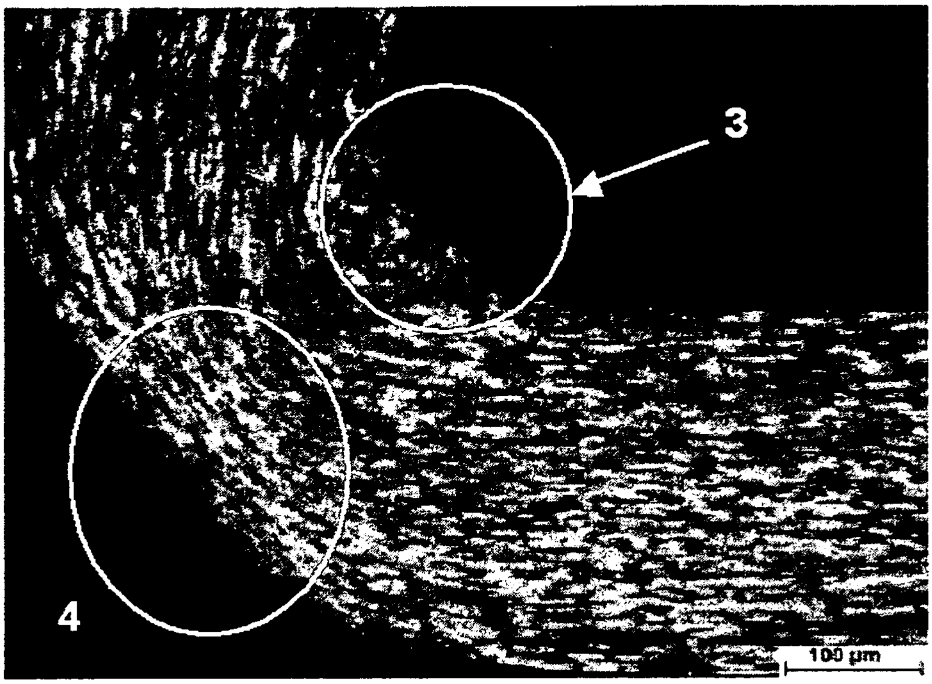


Figure 6

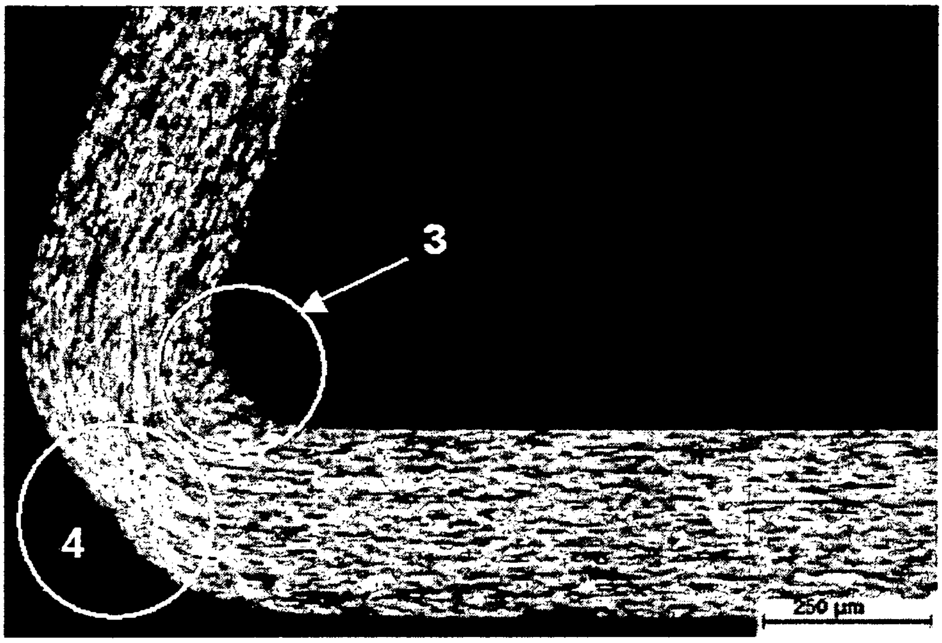


Figure 6a

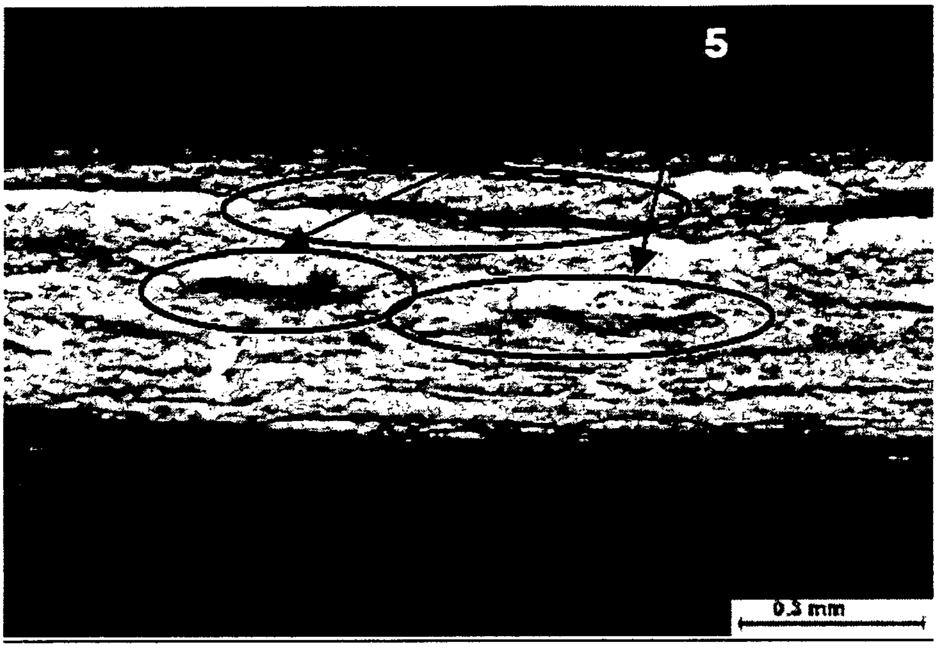
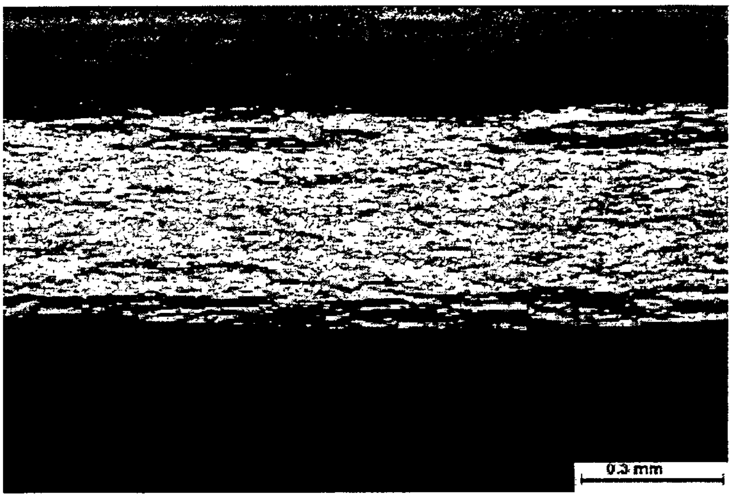


Figure 7



Generally smoother outer surface.

Figure 8