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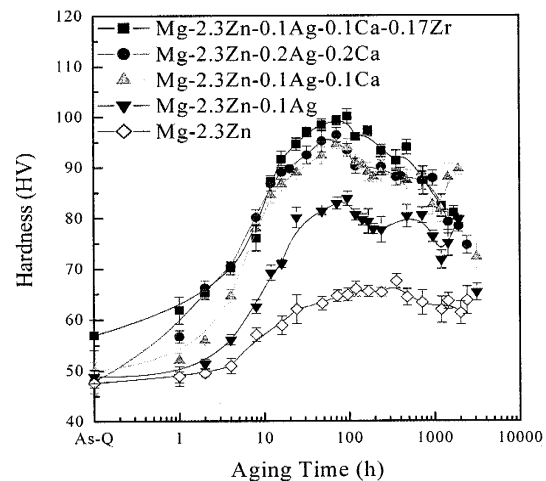
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(74) Representative: **Calamita, Roberto****Dehns****St Bride's House****10 Salisbury Square****London****EC4Y 8JD (GB)**(54) **Mg-BASED ALLOY**

(57) An Mg base alloy of this invention is **characterized in that** Ag is contained in an amount of not more than 1.98 at% as an additive material other than Zn. There is provided an Mg base alloy having not only a practically sufficient strength but good ductility at room temperature to an extent that it has hitherto been unable to be desired and having small anisotropy in strength characteristics.

Fig. 2



Description

TECHNICAL FIELD

5 [0001] This invention relates to an Mg base alloy containing Mg as a main material, realization of which is desired as a lightweight material which is a replacement for Al.

BACKGROUND ART

10 [0002] With respect to this Mg base alloy, there have hitherto been developed various alloys disclosed in the following Patent Documents 1 to 8.

[0003] In Patent Documents 2, 3, 4, 6 and 8, in order to contrive to improve strength, a rare earth element, scandium or lithium is added. However, since such a rare earth element is a rare element which is hardly obtainable on the earth, alloys thereof are high in the price and low in the multiplicity of use.

15 [0004] Patent Document 1 is concerned with a quinary alloy containing from 0.3 to 3 % by mass of Ca and simultaneously containing Al, Sr and Mn. In such an alloy, a precipitate (crystal) is formed on the grain boundary of Mg.

[0005] Patent Document 2 is concerned with an Mg alloy which contains 0.3 % or more and not more than 1.0 % of Zr and which in the case of containing Ca, contains 0.2 % or more and not more than 2.0 % of Ca (% means % by mass).

20 [0006] Patent Document 8 discloses an Mg alloy developed as a casting material, which contains from 3 to 8 % by weight of Zn and from 0.8 to 5 % by weight of Ca.

[0007] During the process of experiments of this invention, it has become clear that a grain boundary precipitate is formed because of an excess of the content of Ca, whereby ductility at room temperature is lowered. From this fact, in all of the foregoing Patent Documents 1, 2 and 8, the ductility at room temperature is poor, too.

25 [0008] An alloy of Patent Document 7 is an alloy developed as a casting material. Specifically, it is disclosed that Ca is zero or 0.5 % by weight, and Zn is from 1 % by weight to 7 % by weight; and in combinations of zero, in the case where Ca is zero or 0.5 % by weight, when Zn is zero, then the alloy has a 0.2 % proof stress of less than 75 MPa, whereas when Zn is from 1 % by weight to 7 % by weight, then the alloy has a 0.2 % proof stress of 75 MPa or more and less than 100 MPa. Thus, it is demonstrated that when such an alloy is used as a structural material, its strength is insufficient. Also, according to the foregoing knowledge obtained in the experiments of this Invention made by the present

30 [0009] Patent Document 5 discloses an Mg base alloy containing Mn and Zn as main components of additive materials, and in order to obtain a high strength, it is described to perform a solution heat treatment. However, there is involved such a problem that the process is complicated because, for example, an additional heat treatment of two-stage aging is required.

35 [0010] In Patent Document 8, an alloy in which not more than 10 % by weight of Cu is added is developed. However, the addition of Cu encounters a defect that the corrosion resistance of the Mg alloy is remarkably lowered.

[0011] In summary, most of members in which an Mg alloy is used are currently manufactured by a casting or die casting method. In the future, though applications of an Mg alloy to transportation equipment such as automobiles, aircrafts, etc. are expected, the casting method involves such defects that the structure of the material is coarse; the ductility is low; and the size is limited so that the Mg alloy is not applicable to plate materials, rod materials, pipe materials, etc. On the other hand, a wrought Mg alloy which is practically useful includes Mg-Al-Zn (AZ based alloy) and Mg-Zn-Zr (ZK based alloy). However, the strength of such a wrought Mg alloy is insufficient, and a proof stress to be used for strength design is largely different between the case where a tensile load is applied and the case where a compression load is applied due to influences of the texture to be formed at the time of hot working (in commercially available AZ31 alloy rolled materials, the compression proof stress is about 50 % of the tensile proof stress). Therefore, it is difficult to use such a wrought Mg alloy as it is. Up to date, in order to realize a high strength of an Mg alloy, there have been adopted methods for adding a rare earth element or adding large amounts of alloying elements.

45 [0012] However, since the rare earth element is expensive, its multiplicity of use is low; and furthermore, the addition of large amounts of alloying elements is accompanied with the formation of a coarse compound phase and involves such a defect that though a high strength is obtained, the ductility is impaired. Then, the development of a new wrought Mg alloy which is free from a rare earth element and which is excellent in strength and ductility by the addition of inexpensive alloying elements is being demanded.

55 Patent Document 1: JP-A-2007-70688
 Patent Document 2: JP-A-2006-28548
 Patent Document 3: JP-A-2006-16658
 Patent Document 4: JP-A-2005-113235
 Patent Document 5: JP-T-2004-510057

Patent Document 6: JP-A-2003-226929

Patent Document 7: JP-A-2002-212662

Patent Document 8: JP-A-6-25791

DISCLOSURE OF INVENTION

PROBLEMS THAT THE INVENTION IS TO SOLVE

[0013] In view of such circumstances, an object of this invention is to provide an Mg base alloy having not only a practically sufficient strength but good ductility at room temperature to an extent that it has hitherto been unable to be desired and having small anisotropy in strength characteristics.

MEANS FOR SOLVING THE PROBLEMS

[0014] An Mg base alloy of Invention 1 is **characterized in that** Ag is contained in an amount of not more than 1.98 at% as an additive material other than Zn.

[0015] Invention 2 is **characterized in that** In the Mg base alloy as set forth in Invention 1, Ca is further contained in an amount of not more than 0.61 at% as an additive material other than Zn and Ag.

[0016] Invention 3 is **characterized in that** in the Mg base alloy as set forth in Invention 2, Zr is further contained in an amount of not more than 0.17 at% as an additive material other than Zn, Ag and Ca.

[0017] Invention 4 is **characterized in that** in the Mg base alloy as set forth in any one of Inventions 1 to 3, a crystal grain size thereof is from 0.1 μm to 25 μm .

ADVANTAGES OF INVENTION

[0018] According to Inventions 1 to 4, it has become possible to provide an Mg base alloy having excellent strength and ductility to an extent that both of them have hitherto been unable to be desired and having small anisotropy in strength, by the addition of inexpensive alloying elements.

[0019] Furthermore, since alloying elements which impair corrosion resistance, such as Cu, etc., are not used, excellent durability can also be expected.

[0020] The alloy of this invention has an average Schmid factor in the bottom slip direction against the load application direction of 0.2 or more and has uniform distribution of the Schmid factor as compared with extruded materials of the existing AZ91 alloy (Mg-9 mass % Al-1 mass % Zn alloy) which is a practical Mg alloy. Namely, the alloy of this invention is **characterized in that** a degree of integration of the bottom parallel to the extrusion direction is weak.

[0021] The alloy of this invention has such excellent mechanical properties that the compression proof stress is 75 % or more of the tensile proof stress and that anisotropy in strength is small.

BRIEF DESCRIPTION OF DRAWINGS

[0022]

Fig. 1 is a flow showing experimental procedures of Example 1.

Fig. 2 is a graph showing an age hardening curve of each of alloys of Example 1 at 160°C.

Fig. 3 is a graph showing an age hardening curve of each of alloys of Example 1 at 200°C.

Fig. 4 is a TEM micrograph of an Mg-2.3 % Zn alloy of Example 1 at the peak aging stage when aged at 160°C.

Fig. 5 is a TEM micrograph of an Mg-2.3 % Zn-0.1 % Ag alloy of Example 1 at the peak aging stage when aged at 160°C.

Fig. 6 is a TEM micrograph of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca alloy of Example 1 at the peak aging stage when aged at 160°C.

Fig. 7 is a TEM micrograph of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca alloy of Example 1 at the peak aging stage when aged at 160°C and is a high-magnification photograph of Fig. 6.

Fig. 8 is a TEM micrograph of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy of Example 1 at the peak aging stage when aged at 160°C.

Fig. 9 is a TEM micrograph of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy of Example 1 at the peak aging stage when aged at 160°C and is a high-magnification micrograph of Fig. 8.

Fig. 10 is a flow showing experimental procedures of Example 2.

Fig. 11 is an aging curve of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca alloy of Example 2 at 160°C and is a graph showing the comparison between a material having been subjected to a solution heat treatment after casting and a material

having been subjected to a solution heat treatment for one hour after hot extrusion.

Fig. 12 is an aging curve of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca alloy of Example 2 at 200°C and is a graph showing the comparison between a material having been subjected to a solution heat treatment after casting and materials having been subjected to a solution heat treatment for 0.5 hours and one hour, respectively after hot extrusion.

Fig. 13 is an aging curve of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy of Example 2 at 160°C and is a graph showing the comparison between a material having been subjected to a solution heat treatment after casting and a material having been subjected to a solution heat treatment for one hour after hot extrusion.

Fig. 14 is an aging curve of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy of Example 2 at 200°C and is a graph showing the comparison between a material having been subjected to a solution heat treatment after casting and materials having been subjected to a solution heat treatment for one hour and 4 hours, respectively after hot extrusion.

Fig. 15 is an optical micrograph of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca alloy of Example 2 as extruded at 350°C.

Fig. 16 is an optical micrograph of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy of Example 2 as extruded at 350°C.

Fig. 17 is a TEM micrograph of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.1 % Zr alloy of Example 2 as extruded at 350°C.

Fig. 18 is a high-magnification micrograph of Fig. 17.

Fig. 19 is a graph showing distribution of a Schmid factor in the bottom slip direction against the tensile load application direction of each of samples of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca alloy and an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy of Example 2 as extruded at 300°C and 350°C, respectively and showing that the distribution is more uniform than that of an extruded material of an existing AZ91 alloy at 400°C and that a degree of the bottom texture is small.

Fig. 20 is a graph showing a stress-strain curve obtained by each of a tensile test and a compression test at room temperature of an extruded material of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy of Example 2 at 350°C.

BEST MODE FOR CARRYING OUT THE INVENTION

[0023] It is noted from the following Examples that according to the invention of this application, age hardening properties are enhanced by adding trace amounts of Ag, Ca and Zr, each of which is free from a rare earth element and is relatively easily available. Also, it is noted that even by merely hot extruding the alloy, a fine grain structure having a fine precipitate dispersed therein is formed and that the subject alloy is an Mg base alloy which is excellent in not only strength but ductility and which has small anisotropy in strength as compared with the conventional alloys. Also, in view of the Examples and the technical common knowledge, it can be expected that the foregoing effects are displayed within the following ranges.

[0024] With respect to Zn, the maximum solubility of Zn in Mg is 2.4 at%.

[0025] So far as the composition range of Zn is 0.75 at% or more, age hardening is achieved. However, In order to contrive to realize a high strength by dispersing a rod-like β' -precipitate which works as a strengthening phase of an Mg-Zn based alloy, it is necessary that the Zn content is as high as possible, and the Zn content is preferably 1.52 at% or more.

[0026] In order to disperse this rod-like β' -precipitate in a larger amount and finely, the Zn content is preferably 1.92 at% or more.

[0027] With respect to Ag, the solubility of Ag in Mg is large, and Its maximum solid solution amount is 3.82 at%.

[0028] In the case where a solution heat treatment after casting is performed at 400°C, when the Ag content exceeds 1.98 at%, there is a concern that a coarse precipitate is formed, thereby deteriorating mechanical properties.

[0029] When the Ag content exceeds 0.2 at%, even by Increasing the addition amount, age hardening properties do not change too much. Therefore, in order to Inhibit the formation of a compound phase with Zn or Ca or Zr as a constituent element, in a sense of suppressing the Ag content, an upper limit thereof is preferably 0.2 at%.

[0030] Also, when the Ag content is 0.08 at% or more, a work for promoting the formation of a nucleus of the precipitate is revealed, and therefore, a lower limit value thereof is preferably 0.08 at% or more.

[0031] With respect to Ca, the maximum solubility of Ca in Mg is 0.82 at%.

[0032] In the case where a solution heat treatment after casting is performed at 400°C. when the Ca content exceeds 0.61 at%, a grain boundary precipitate is formed, thereby impairing mechanical properties.

[0033] Therefore, its upper limit was specified to be not more than 0.81 at%.

[0034] Also, as shown In Figs. 2 and 3 of Example 1, even by doubling the addition amount of Ca, changes in age hardening characteristics are not noticed. Therefore, in order to inhibit the formation of a compound phase with Zn or Ag or Zr as a constituent element, in a sense of suppressing the Ca content, an upper limit thereof is preferably 0.2 at%.

[0035] Also, when the Ca content is 0.08 at% or more, a work for promoting the formation of a nucleus of the precipitate is revealed, and therefore, a lower limit value thereof is preferably 0.08 at% or more.

[0036] With respect to Zr, the maximum solubility of Zr in Mg is 1.04 at%.

[0037] However, when the Zr content exceeds 0.17 at%, a peritectic reaction exists in the vicinity of 650°C, and a coarse precipitate is formed. Therefore, the Zr content was specified to be not more than 0.17 at%.

[0038] When the Zr content is 0.08 at% or more, an effect for inhibiting grain coarsening in the solution heat treatment and hot extrusion is expected due to a fine precipitate or the Zr atom itself. Therefore, a lower limit of the Zr content is preferably 0.08 at% or more.

[0039] The foregoing specific addition amount of each of the elements is distributed on the basis of results of the following Examples such that an average grain size of the fine grain structure is as small as possible and that orientation properties of the crystal grain are weakened.

Example 1

[0040] Respective elements were blended so as to have an alloy composition shown in Table 1 and smelted in a high-frequency melting furnace using an Iron-made crucible in an argon atmosphere.

[Table 1]

Alloy composition

Alloy	Composition (at%)					Composition (wt%)				
	Zn	Ag	Ca	Zr	Mg	Zn	Ag	Ca	Zr	Mg
Mg-2.3Zn	2.32 -	-	-	-	Bal.	6.0	-	-	-	Bal.
Mg-2.3Zn-0.1Ag	2.33	0.09	-	-	Bal.	6.0	0.4	-	-	Bal.
Mg-2.3Zn-0.1Ag-0.1Ca	2.33	0.10	0.09	-	Bal.	6.0	0.4	0.16	-	Bal.
Mg-2.3Zn-0.2Ag-0.2Ca	2.33	0.2	0.2	-	Bal.	6.0	0.85	0.31	-	Bal.
Mg-2.3Zn-0.1Ag-0.1Ca-0.1Zr	2.34	0.09	0.10	0.17	Bal.	6.0	0.4	0.16	0.6	Bal.

[0041] After sealing in a PYREX (registered trademark) tube together with an argon gas, the melted material was subjected to a homogenization heat treatment at 340°C for 48 hours. The resulting sample was cut out and sealed in a PYREX (registered trademark) tube together with an argon gas; and thereafter, the sample was subjected to a solution heat treatment at 400°C for one hour and then quenched in ice water.

[0042] The quenched material was aged at a temperature of 160°C and 200°C, respectively using an oil bath. Its hardness by aging was measured by a Vickers hardness meter under a condition at a load of 1 kg for a holding time of 15 seconds.

[0043] Microstructure observation was executed using a transmission electron microscope (TEM). Details of experimental procedures are shown in Fig. 1.

[0044] Figs. 2 and 3 show hardness changes in aging at 160°C and 200°C, respectively. From these figures, the hardness reaches the maximum at around 100 hours in the aging at 160°C and at around 10 hours in the aging at 200°C, respectively.

[0045] The age hardening properties become better by adding Ag, (Ag + Ca) or (Ag + Ca + Zr) to the Mg-2.3Zn alloy.

[0046] The maximum hardness of an alloy obtained by adding (Ag + Ca + Zr) to the Mg-2.3Zn alloy is the highest and reaches 100 Hv.

[0047] In an alloy obtained by adding (Ag + Ca) to the Mg-2.3Zn alloy, the aging hardness of each of alloys obtained by increasing the addition amount of each of the elements by 0.2 at% is examined.

[0048] However, even when the addition amount is increased, a distinct difference in the aging characteristics is not observed.

[0049] With respect to each of the alloys shown in Figs. 4, 5, 6 and 8, the grain size was measured by linear intercept method (ASTM standards E112). The average grain size was about 100 μm in the Mg-2.3Zn binary alloy shown in Fig. 4, about 50 μm in the Mg-2.3Zn-0.1Ag alloy shown in Fig. 5, about 50 μm in the Mg-2.3Zn-0.1Ag-0.1Ca alloy shown in Fig. 6 and about 10 μm in the Mg-2.3Zn-0.1Ag-0.1Ca-0.17Zr alloy shown in Fig. 8, respectively. It is noted that by the addition of Ag or combined addition of (Ag + Ca), the crystal grain size becomes small and that by the further addition of Zr, the grain size becomes finer.

[0050] Each of Figs. 4 to 9 shows a TEM micrograph of each of the alloys at the peak aging stage when aged at 160°C.

[0051] In all of the aging structures, a rod-like precipitate extending to the c-axis direction of Mg is observed.

[0052] By adding Ag, (Ag + Ca) or (Ag + Ca + Zr) to the Mg-2.3Zn alloy, the precipitate becomes fine.

[0053] This refinement of the precipitate is considered to cause an increase of the peak aging hardness.

[0054] In conclusion, good age hardening properties are obtained in alloys by the combined addition of (Ag + Ca) and

(Ag + Ca + Zr), respectively.

Example 2

[0055] Details of experimental procedures are shown in Fig. 10. Alloying elements were blended so as to have an alloy composition shown in Table 1 and melted and cast in a ($\text{CO}_2 + \text{SF}_6$) mixed gas atmosphere. Thereafter, the ingot was subjected to a homogenous heat treatment at 350°C for 48 hours. Thereafter, the ingot was hot extruded at 300°C and 350°C , respectively. With respect to the hot extrusion condition, an extrusion ratio was 20, and a ram rate was 0.1 mm/s. The material after extrusion was subjected to a solution heat treatment at 400°C for from 0.5 to 4 hours and then subjected to an aging treatment at a temperature of 160°C and 200°C , respectively, followed by measurement for a Vickers hardness.

[0056] Also, the sample after extrusion was subjected to microstructure observation by an optical microscope and TEM.

[0057] Figs. 11 and 12 show an aging curve of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca alloy at 160°C and 200°C , respectively.

[0058] Comparison was made between a material having been subjected to a solution heat treatment after casting and a material having been subjected to a solution heat treatment after hot extrusion. As a result, the both are substantially identical to each other with respect to the maximum hardness and age hardening characteristics.

[0059] Figs. 13 and 14 show an aging curve of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy at 160°C and 200°C , respectively.

[0060] Comparison was made between a material having been subjected to a solution heat treatment after casting and a material having been subjected to a solution heat treatment after hot extrusion. As a result, the both are not distinctly different from each other with respect to the maximum hardness and age hardening characteristics.

[0061] Fig. 15 shows an optical micrograph structure of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca alloy when hot extruded at 350°C . The crystal grain size was measured by linear intercept method using this photograph. As a result, the average crystal grain size was $20\text{ }\mu\text{m}$.

[0062] Fig. 16 shows an optical micrograph of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy when hot extruded at 350°C . Figs. 17 and 18 are each a TEM micrograph of the same alloy.

[0063] In the optical micrograph of Fig. 16, the structure after extrusion is classified into three of (A) a coarse unrecrystallized grain, (B) a fine equi-axed recrystallized grain and (C) an obscure region. The obscure region (C) is considered to be corresponding to the TEM micrograph of Fig. 17, and it is noted that the obscure region (C) is a fine grained recrystallized grain structure in a submicron order.

[0064] Fig. 18 shows enlargement of the interior of the fine grain in a submicron order, and fine rod-like precipitates of several tens nm as formed along the c-axis of Mg.

[0065] The grain size of the hot extruded Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy was measured from Figs. 16 and 17. Since the obtained structure was not homogenous, the major axis and the minor axis were measured for crystals of the respective regions without employing the linear intercept method, and an average value thereof was defined as the grain size. Also, with respect to the unrecrystallized grain (A) and the equi-axed recrystallized grain (B), the optical micrograph of Fig. 16 was used, and with respect to the fine grain region in a submicron order (C), the TEM micrograph of Fig. 17 was used. As a result, it was noted that the unrecrystallized grain (A) had size distribution of from about 5 to $25\text{ }\mu\text{m}$ and had an average grain size of $11\text{ }\mu\text{m}$; the equi-axed recrystallized grain (B) had size distribution of from about 1 to $5\text{ }\mu\text{m}$ and had an average grain size of $2.8\text{ }\mu\text{m}$; and the fine grain region in a submicron order (C) had size distribution of from about 0.1 to $1\text{ }\mu\text{m}$ and had an average grain size of $0.75\text{ }\mu\text{m}$.

[0066] With respect to the Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca alloy and the Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy each having excellent age hardening properties, a tensile test at room temperature and a compression test at room temperature were executed in parallel to the extrusion direction. A tensile specimen was a JIS 14B specimen and had a gauge length of 20 mm. A compression specimen had a diameter of 9.5 mm and a height of 14.3 mm. The tensile test and the compression test were performed under a condition at an initial strain rate of 10^{-3} s^{-1} .

[0067] Fig. 19 (measurement data on which this figure is based are shown in Table 2) shows distribution of a Schmid factor in the basal slip direction against the tensile load application direction, namely the extrusion direction. Since the degree of integration of the basal texture parallel to the extrusion direction is weak, the Schmid factors of the alloys of this invention are uniformly distributed as compared with those of extruded materials of the existing AZ91 alloy (Mg-9 mass % Al-1 mass % Zn alloy), and an average value thereof is 0.20 or more.

[Table 2]

Chart: Schmid Factor											
Mg-2.3Zn-0.1Ag-0.1Ca						Mg-2.3Zn-0.1Ag-0.1Ca-0.17Zr					
extruded at 300°C			extruded at 350°C			extruded at 300°C			extruded at 350°C		
(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
0.013	0.062	6.177	0.013	0.074	7.387	0.013	0.121	12.112	0.013	0.131	13.064
0.037	0.068	6.793	0.038	0.051	5.078	0.038	0.100	9.978	0.038	0.087	8.709
0.062	0.062	6.151	0.063	0.073	7.285	0.063	0.086	8.557	0.063	0.093	9.268
0.087	0.063	6.303	0.088	0.062	6.183	0.088	0.066	6.649	0.088	0.093	9.296
0.112	0.058	5.811	0.113	0.085	8.472	0.113	0.050	5.010	0.112	0.054	5.403
0.137	0.053	5.337	0.137	0.058	5.812	0.138	0.046	4.589	0.137	0.034	3.440
0.162	0.054	5.440	0.162	0.043	4.285	0.163	0.049	4.888	0.162	0.036	3.596
0.187	0.050	5.032	0.187	0.050	4.962	0.188	0.033	3.308	0.187	0.025	2.516
0.212	0.042	4.240	0.212	0.056	5.641	0.213	0.033	3.275	0.212	0.027	2.700
0.237	0.043	4.314	0.237	0.059	5.883	0.238	0.035	3.468	0.237	0.030	2.996
0.262	0.052	5.158	0.262	0.048	4.752	0.263	0.043	4.251	0.262	0.040	4.012
0.287	0.046	4.598	0.287	0.025	2.526	0.288	0.039	3.895	0.287	0.028	2.758
0.312	0.043	4.318	0.312	0.039	3.862	0.313	0.036	3.550	0.312	0.042	4.175
0.337	0.041	4.062	0.337	0.037	3.672	0.338	0.030	3.039	0.337	0.044	4.351
0.362	0.049	4.859	0.362	0.042	4.227	0.363	0.041	4.079	0.362	0.042	4.164
0.387	0.044	4.447	0.387	0.028	2.848	0.388	0.049	4.945	0.387	0.040	4.017
0.412	0.049	4.886	0.412	0.042	4.248	0.413	0.035	3.533	0.412	0.041	4.056
0.437	0.053	5.287	0.437	0.037	3.697	0.437	0.039	3.897	0.437	0.055	5.519
0.462	0.035	3.494	0.462	0.050	5.004	0.462	0.040	3.956	0.462	0.040	4.003
0.487	0.033	3.295	0.487	0.042	4.176	0.487	0.030	3.020	0.487	0.020	1.958
Average		0.228	22.824	0.220	22.020	0.200	19.983	0.199	19.864		
(1): Schmid Factor											
(2): Number Fraction											
(3): (2)×100											

[0068] Fig. 20 shows a stress-strain curve obtained by each of a tensile test and a compression test at room temperature of an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy as extruded at 350°C. Tables 3 to 7 show measurement data corresponding to the stress-strain curve in the tensile test shown in Fig. 20; and Tables 8 to 11 show measurement data corresponding to the stress-strain curve in the compression test shown in Fig. 20.

(Initial strain rate: 10^{-3} s $^{-1}$; shape of tensile specimen: JIS 14B (gauge length: 20 mm); and shape of compression specimen: 9.5 mm in diameter and 14.3 mm in height)

tensile test: table 1 (1) Strain (%) (2) Stress (MPa)									
(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
0.000	2.462	0.061	35.969	0.174	88.356	0.210	117.760	0.368	176.966
0.000	2.537	0.068	36.005	0.177	88.903	0.210	118.421	0.365	176.513
0.000	2.636	0.068	36.929	0.171	88.450	0.207	119.018	0.365	177.500
0.001	2.810	0.063	37.976	0.167	89.997	0.204	119.616	0.373	177.731
0.001	3.034	0.067	37.924	0.160	90.544	0.207	120.734	0.372	178.850
0.001	3.064	0.064	38.946	0.171	91.061	0.207	121.062	0.378	179.472
0.001	3.077	0.074	38.844	0.172	91.514	0.207	121.062	0.378	179.472
0.001	3.531	0.077	39.814	0.170	92.533	0.214	122.000	0.378	180.541
0.002	3.631	0.072	39.814	0.174	93.230	0.225	123.047	0.380	181.213
0.006	3.830	0.072	40.261	0.174	93.230	0.225	123.047	0.378	181.586
0.008	4.178	0.070	40.858	0.184	93.702	0.219	124.643	0.378	181.586
0.005	4.178	0.070	41.306	0.184	94.225	0.219	124.643	0.387	182.406
0.004	4.402	0.077	41.778	0.192	94.772	0.225	124.862	0.387	182.406
0.001	4.725	0.073	42.276	0.182	95.148	0.226	125.334	0.384	183.451
0.003	4.824	0.082	42.773	0.181	95.518	0.223	126.006	0.381	184.097
0.004	5.073	0.085	43.258	0.184	95.841	0.226	126.628	0.397	184.620
0.005	5.222	0.070	43.768	0.194	96.214	0.236	127.200	0.399	186.231
0.004	5.471	0.076	44.240	0.186	96.761	0.242	127.772	0.395	186.838
0.006	5.695	0.076	44.737	0.178	97.263	0.235	128.940	0.390	186.908
0.003	5.919	0.076	45.295	0.187	97.821	0.235	129.587	0.407	187.604
0.000	6.217	0.087	45.807	0.192	98.276	0.233	129.587	0.406	188.076
0.003	6.391	0.087	46.329	0.185	98.825	0.241	130.124	0.406	188.076
0.001	6.640	0.081	46.727	0.197	99.223	0.232	130.706	0.403	188.622
0.001	6.864	0.089	47.324	0.196	99.770	0.248	131.328	0.398	188.046
0.001	7.162	0.090	47.796	0.190	100.241	0.239	131.900	0.405	188.743
0.010	7.336	0.085	48.318	0.195	100.641	0.236	132.447	0.412	190.339
0.006	7.659	0.085	48.866	0.187	101.138	0.247	133.118	0.408	190.911
0.003	7.883	0.093	49.363	0.180	101.536	0.249	133.715	0.413	191.558
0.004	8.182	0.094	49.885	0.203	102.083	0.248	134.262	0.417	192.080
0.000	8.495	0.085	50.358	0.196	102.481	0.248	134.809	0.415	192.607
0.011	8.729	0.097	50.905	0.202	102.854	0.248	135.356	0.419	193.190
0.018	9.102	0.092	51.377	0.195	103.202	0.246	136.028	0.418	193.821
0.009	9.325	0.089	51.924	0.196	103.609	0.259	136.649	0.424	194.418
0.008	9.649	0.099	52.397	0.198	104.048	0.261	137.246	0.424	194.418
0.008	9.922	0.104	52.919	0.197	104.321	0.268	137.744	0.428	195.681
0.015	10.196	0.109	53.466	0.197	104.625	0.267			

[Table 3]-2

0.013	15.518	0.117	61.921	0.131	87.013	0.286	147.790	0.448	205.136	0.549	258.129	0.905	293.467	1.257	305.155	1.676	310.874
0.017	15.841	0.126	62.419	0.133	87.510	0.293	148.387	0.446	205.708	0.547	258.602	0.914	293.467	1.269	305.180	1.677	310.949
0.015	16.164	0.123	62.966	0.139	88.207	0.300	148.994	0.457	206.855	0.651	259.049	0.909	293.966	1.279	305.229	1.681	310.874
0.026	16.612	0.117	63.538	0.140	88.828	0.299	149.581	0.455	206.862	0.658	259.472	0.918	294.065	1.282	305.329	1.688	310.949
0.026	17.010	0.126	64.010	0.141	89.574	0.298	150.153	0.461	207.449	0.657	259.771	0.928	294.287	1.281	305.403	1.684	310.999
0.027	17.283	0.124	64.582	0.147	90.246	0.298	150.760	0.459	207.996	0.653	260.392	0.920	294.462	1.290	305.478	1.686	310.999
0.025	17.731	0.137	65.055	0.138	90.868	0.285	151.396	0.463	208.568	0.674	260.915	0.923	294.760	1.284	305.528	1.705	311.173
0.021	17.880	0.131	65.602	0.145	91.489	0.296	151.993	0.471	209.090	0.661	261.513	0.922	294.969	1.303	305.652	1.713	311.247
0.019	18.502	0.129	66.223	0.154	92.185	0.299	152.490	0.470	209.712	0.670	262.332	0.939	295.133	1.291	305.528	1.717	311.293
0.022	18.875	0.128	66.686	0.146	92.807	0.292	153.137	0.472	210.283	0.670	262.332	0.933	295.282	1.307	305.652	1.708	311.297
0.019	19.099	0.136	67.243	0.142	93.479	0.295	153.734	0.473	210.806	0.675	262.631	0.931	295.407	1.310	305.901	1.722	311.347
0.024	19.496	0.128	67.815	0.157	94.175	0.293	154.281	0.479	211.427	0.676	263.078	0.940	295.705	1.316	305.801	1.713	311.471
0.031	19.919	0.129	68.952	0.154	94.846	0.315	154.878	0.482	211.950	0.674	263.551	0.944	295.879	1.318	305.851	1.727	311.495
0.024	20.292	0.140	68.859	0.157	95.518	0.311	155.499	0.489	212.497	0.667	264.023	0.940	295.053	1.323	305.950	1.725	311.496
0.035	20.715	0.128	69.382	0.160	96.189	0.309	156.022	0.483	213.044	0.680	264.596	0.942	296.128	1.324	306.050	1.740	311.620
0.029	21.163	0.127	69.756	0.169	96.811	0.312	156.594	0.490	213.616	0.688	264.919	0.952	296.401	1.324	306.075	1.736	311.646
0.029	21.511	0.137	70.526	0.155	97.457	0.319	157.141	0.493	214.188	0.682	265.516	0.951	296.600	1.345	306.100	1.752	311.645
0.027	21.958	0.139	70.958	0.164	98.204	0.305	157.738	0.485	214.760	0.687	265.764	0.954	296.849	1.340	306.249	1.748	311.695
0.028	22.331	0.140	71.545	0.164	98.825	0.317	158.260	0.486	215.292	0.679	265.212	0.961	297.073	1.334	306.274	1.756	311.770
0.030	22.904	0.137	72.117	0.170	99.397	0.315	158.906	0.490	215.804	0.694	265.585	0.960	297.172	1.341	306.274	1.750	311.819
0.029	23.202	0.137	72.664	0.171	100.094	0.315	159.503	0.491	216.476	0.692	267.455	0.964	297.495	1.350	306.423	1.763	311.869
0.032	23.550	0.137	73.211	0.160	100.765	0.320	160.100	0.496	217.172	0.705	267.977	0.978	297.645	1.352	306.373	1.766	311.869
0.029	24.047	0.145	73.758	0.170	101.387	0.320	160.672	0.496	217.599	0.697	268.325	0.978	297.784	1.358	306.423	1.770	312.043
0.039	24.446	0.146	74.905	0.177	102.043	0.315	161.269	0.495	218.067	0.697	268.748	0.992	297.968	1.350	306.597	1.771	312.083
0.039	24.843	0.146	74.753	0.168	102.530	0.325	161.915	0.504	218.614	0.703	268.748	0.992	297.968	1.350	306.597	1.769	312.118
0.032	25.266	0.155	75.524	0.164	103.326	0.315	162.338	0.507	219.136	0.710	269.121	0.990	298.217	1.386	306.771	1.777	312.192
0.043	25.689	0.145	75.897	0.172	104.072	0.332	162.885	0.499	219.733	0.715	269.519	0.983	298.366	1.376	306.721	1.777	312.292
0.026	26.062	0.143	75.469	0.176	104.595	0.322	163.532	0.509	220.231	0.713	269.817	1.000	298.515	1.372	306.896	1.789	312.297
0.044	26.589	0.146	76.965	0.170	105.241	0.324	164.178	0.514	220.653	0.710	270.340	1.004	298.540	1.384	306.846	1.792	312.391
0.037	26.982	0.146	77.588	0.176	105.838	0.331	164.701	0.512	221.399	0.716	271.235	1.008	298.764	1.387	306.945	1.792	312.391
0.037	27.429	0.149	78.110	0.176	106.485	0.333	165.173	0.512	221.922	0.722	271.633	1.011	298.037	1.394	307.020	1.799	312.541
0.042	27.877	0.149	78.608	0.184	107.106	0.325	165.869	0.516	222.543	0.725	272.006	0.984	298.988	1.396	307.144	1.811	312.516
0.042	28.350	0.145	79.180	0.176	107.629	0.340	166.466	0.510	223.096	0.726	272.364	1.016	299.261	1.401	307.144	1.808	312.541
0.043	28.648	0.157	79.727	0.188	108.399	0.343	167.038	0.510	223.513	0.730	272.851	1.015	299.361	1.404	307.119	1.809	312.541
0.047	29.170	0.162	80.299	0.186	108.922	0.344	167.535	0.520	224.707	0.725	273.199	1.030	299.699	1.412	307.269	1.817	312.915
0.049	29.593	0.157	80.771	0.193	109.518	0.338	168.132	0.520	224.707	0.727	273.498	1.021	299.684	1.414	307.318	1.815	312.715
0.047	30.095	0.154	81.318	0.187	110.090	0.344	168.754	0.518	225.204	0.732	273.921	1.029	299.758	1.420	307.358	1.827	312.739
0.053	30.458	0.156	81.865	0.194	110.662	0.345	169.276	0.535	225.851	0.739	274.358	1.038	299.957	1.425	307.467	1.826	312.864
0.062	30.985	0.144	82.363	0.194	111.284	0.350	169.997	0.529	226.823	0.743	274.716	1.034	299.908	1.425	307.467	1.830	312.864
0.058	31.433	0.164	82.984	0.192	111.931	0.339	170.445	0.527	226.846	0.743	274.716	1.034	299.908	1.425	307.467	1.830	312.864
0.057	31.831	0.157	83.556	0.194	112.503	0.358	170.967	0.534	227.417	0.741	275.056	1.042	300.082	1.428	307.567	1.838	312.889
0.054	32.279	0.167	84.103	0.204	113.050	0.353	171.564	0.536	228.014	0.743	275.357	1.045	300.256	1.437	307.617	1.835	312.963
0.059	32.701	0.163	84.700	0.201	113.647	0.357	171.962	0.532	228.537	0.757	275.860	1.063	300.406	1.434	307.641	1.841	313.063
0.055	33.224	0.161	85.123	0.196	114.368	0.352	172.509	0.540	228.984	0.751	276.233	1.051	300.504	1.440	307.741	1.846	313.088
0.059	33.721	0.172	85.720	0.196	114.915	0.358	173.056	0.540	229.357	0.748	276.656	1.052	300.753	1.451	307.716	1.850	313.137
0.061	34.094	0.172	86.242	0.199	115.382	0.358	173.603	0.543	230.000	0.756	277.955	1.062	300.753	1.451	307.716	1.855	313.162
0.061	34.591	0.163	86.739	0.206	116.059	0.365	174.250	0.543	230.700	0.749	277.427	1.061	300.853	1.465	307.841	1.867	313.262
0.059	35.014	0.164	87.262	0.206	116.680	0.360	174.822	0.540	231.173	0.753	277.775	1.065	300.977	1.459	307.949	1.866	313.237
0.056	35.437	0.173	87.834	0.202	117.352	0.366	175.344	0.547	231.720	0.771	278.148	1.073	301.076	1.469	307.990	1.863	313.311

tensile test: table2; (1) Strain (%)	(2) Stress (MPa)
0	0
10	100
20	200
30	300
40	400
50	500
60	600
70	700
80	800
90	900
100	1000

[illegible]

2.084	316.923	2.475	320.672	2.891	324.925	3.277	328.555	3.684	331.938	4.088	334.847	4.479	337.583	4.899	339.821	5.290	341.835
2.093	315.873	2.484	320.747	2.885	324.974	3.286	328.530	3.677	331.987	4.081	334.971	4.504	337.483	4.890	339.846	5.300	341.984
2.098	316.072	2.484	320.672	2.882	324.900	3.283	328.705	3.676	331.987	4.078	334.947	4.482	337.632	4.898	339.846	5.294	341.934
2.099	315.997	2.491	320.697	2.888	324.950	3.289	328.779	3.703	331.962	4.081	334.897	4.482	337.607	4.902	339.870	5.316	341.959
2.099	316.146	2.499	320.747	2.888	324.925	3.311	328.754	3.715	332.112	4.084	334.996	4.492	337.633	4.899	339.870	5.331	341.959
2.112	316.246	2.502	320.772	2.896	325.074	3.289	328.754	3.699	332.136	4.107	335.021	4.511	337.583	4.908	339.895	5.316	341.910
2.110	316.171	2.505	320.896	2.904	325.099	3.305	328.754	3.709	332.161	4.110	335.021	4.511	337.732	4.905	340.020	5.319	341.910
2.112	316.296	2.503	320.822	2.910	325.124	3.321	328.879	3.709	332.161	4.110	335.021	4.511	337.732	4.921	339.945	5.338	341.984
2.117	316.345	2.507	320.971	2.917	325.273	3.324	328.829	3.715	332.211	4.122	335.170	4.536	337.732	4.931	339.970	5.331	342.009
2.116	316.395	2.515	321.045	2.901	325.198	3.324	328.904	3.706	332.236	4.119	335.096	4.527	337.682	4.921	339.920	5.322	342.009
2.121	316.445	2.514	321.045	2.920	325.223	3.335	329.227	3.725	332.251	4.113	335.170	4.523	337.707	4.921	340.034	5.344	342.009
2.121	316.494	2.521	321.120	2.920	325.323	3.333	328.978	3.734	332.296	4.132	335.120	4.533	337.681	4.940	340.094	5.341	342.084
2.133	316.519	2.527	321.170	2.929	325.298	3.327	329.103	3.722	332.311	4.126	335.295	4.523	337.682	4.937	340.094	5.341	342.133
2.146	316.619	2.541	321.195	2.936	325.497	3.327	329.053	3.731	332.410	4.129	335.245	4.536	337.782	4.934	340.119	5.338	342.168
2.150	316.694	2.528	321.269	2.942	325.402	3.336	329.177	3.734	332.435	4.132	335.295	4.533	337.782	4.946	340.144	5.350	342.283
2.144	316.644	2.551	321.294	2.932	325.397	3.349	329.177	3.744	332.485	4.138	335.320	4.533	337.881	4.953	340.069	5.350	342.283
2.149	316.793	2.554	321.394	2.945	325.397	3.343	329.396	3.750	332.460	4.151	335.369	4.552	337.931	4.956	340.184	5.354	342.283
2.156	316.793	2.547	321.468	2.955	325.571	3.346	329.392	3.747	332.510	4.157	335.394	4.574	338.055	4.978	340.194	5.360	342.208
2.161	316.917	2.557	321.543	2.961	325.472	3.371	329.358	3.753	332.510	4.154	335.494	4.574	338.055	4.981	340.268	5.382	342.283
2.166	316.917	2.550	321.543	2.958	325.671	3.374	329.351	3.744	332.594	4.164	335.459	4.577	338.030	4.985	340.417	5.386	342.233
2.161	316.992	2.551	321.518	2.970	325.621	3.371	329.325	3.763	332.659	4.154	335.519	4.568	338.080	4.981	340.268	5.386	342.283
2.171	317.091	2.569	321.592	2.973	325.795	3.368	329.425	3.765	332.609	4.179	335.543	4.583	337.956	4.994	340.318	5.401	342.332
2.182	317.141	2.565	321.692	2.983	325.770	3.362	329.425	3.772	332.659	4.182	335.633	4.583	337.956	4.994	340.318	5.401	342.332
2.172	317.216	2.579	321.756	2.983	325.820	3.394	329.590	3.776	332.783	4.192	335.643	4.580	338.080	4.997	340.268	5.404	342.382
2.186	317.315	2.582	321.816	2.989	325.919	3.383	329.600	3.788	332.808	4.192	335.618	4.602	338.155	4.991	340.317	5.407	342.407
2.195	317.315	2.582	321.891	2.992	325.919	3.383	329.600	3.791	332.758	4.201	335.593	4.599	338.204	5.009	340.442	5.407	342.407
2.197	317.315	2.598	321.891	2.989	325.994	3.393	329.625	3.794	332.907	4.227	335.742	4.596	338.179	5.003	340.383	5.423	342.606
2.195	317.440	2.601	321.941	3.002	326.019	3.393	329.675	3.788	332.863	4.227	335.742	4.605	338.254	5.019	340.542	5.423	342.606
2.206	317.489	2.604	321.990	2.996	326.094	3.409	329.689	3.813	332.863	4.201	335.742	4.631	338.353	5.019	340.517	5.436	342.457
2.211	317.440	2.595	322.055	3.002	326.143	3.406	329.749	3.813	332.858	4.208	335.792	4.631	338.353	5.019	340.517	5.432	342.531
2.218	317.663	2.607	322.065	3.008	326.143	3.419	329.798	3.825	333.007	4.211	335.942	4.615	338.329	5.047	340.517	5.442	342.482
2.209	317.564	2.617	322.140	3.015	326.258	3.412	329.824	3.819	333.007	4.233	335.887	4.624	338.304	5.092	340.467	5.446	342.482
2.229	317.688	2.626	322.164	3.027	326.193	3.409	329.824	3.819	333.032	4.223	335.892	4.631	338.304	5.092	340.467	5.446	342.482
2.221	317.653	2.629	322.264	3.030	326.193	3.419	329.824	3.832	333.106	4.236	335.767	4.631	338.304	5.041	340.591	5.446	342.581
2.229	317.788	2.617	322.065	3.040	326.253	3.422	329.898	3.832	333.106	4.242	335.966	4.628	338.453	5.057	340.716	5.473	342.581
2.233	317.813	2.629	322.139	3.040	326.342	3.434	329.948	3.826	333.131	4.242	335.966	4.628	338.453	5.057	340.716	5.473	342.581
2.232	317.813	2.636	322.289	3.040	326.392	3.434	330.023	3.829	333.106	4.230	335.916	4.650	338.453	5.057	340.716	5.461	342.581
2.236	317.937	2.648	322.438	3.044	326.392	3.441	329.973	3.851	333.032	4.236	335.892	4.646	338.428	5.064	338.229	5.464	342.581
2.250	317.912	2.636	322.563	3.043	326.417	3.447	329.998	3.854	333.131	4.265	336.060	4.656	338.503	5.079	340.691	5.470	342.531
2.252	317.987	2.639	322.588	3.052	326.491	3.441	330.122	3.838	333.231	4.242	336.000	4.665	338.503	5.067	340.691	5.477	342.506
2.249	317.987	2.652	322.613	3.052	326.541	3.447	330.122	3.848	333.231	4.242	336.000	4.665	338.503	5.067	340.691	5.477	342.506
2.261	318.111	2.648	322.587	3.056	326.591	3.453	330.172	3.838	333.280	4.268	336.041	4.669	338.577	5.069	340.716	5.483	342.705
2.277	318.161	2.658	322.612	3.052	326.616	3.453	330.197	3.848	333.280	4.271	336.140	4.672	338.602	5.060	340.791	5.477	342.680
2.275	318.210	2.664	322.687	3.065	326.730	3.469	330.271	3.864	333.355	4.271	336.240	4.681	338.627	5.079	340.741	5.483	342.705

[Table 1]-2

[Table 5] 2																	
5.701	343.625	6.114	345.043	6.518	346.286	6.941	347.381	7.355	348.226	7.787	348.973	8.232	349.265	8.649	349.758	9.072	349.957
5.713	343.601	6.124	345.043	6.515	346.237	6.941	347.405	7.371	348.375	7.800	348.922	8.210	349.370	8.655	349.693	9.066	349.917
5.713	343.501	6.127	344.993	6.524	346.411	6.948	347.430	7.374	348.291	7.806	348.773	8.239	349.345	8.662	349.793	9.085	349.942
5.713	343.625	6.130	345.118	6.534	346.285	6.948	347.430	7.374	348.251	7.809	348.947	8.226	349.330	8.649	349.753	9.085	349.942
5.710	343.625	6.130	345.093	6.525	346.285	6.963	347.405	7.383	348.251	7.809	348.957	8.251	349.345	8.662	349.768	9.091	349.992
5.717	343.625	6.130	345.093	6.572	346.336	6.963	347.381	7.386	348.326	7.819	348.748	8.242	349.370	8.649	349.793	9.097	349.967
5.729	343.700	6.165	345.063	6.572	346.361	6.976	347.430	7.390	348.326	7.813	348.922	8.242	349.356	8.668	349.892	9.104	349.942
5.732	343.576	6.143	345.140	6.553	346.411	6.967	347.430	7.386	348.276	7.815	348.922	8.242	349.345	8.668	349.768	9.100	350.017
5.742	343.775	6.156	345.167	6.556	346.436	6.979	347.381	7.389	348.326	7.838	348.922	8.251	349.494	8.692	349.818	9.104	349.942
5.742	343.725	6.152	345.167	6.572	346.336	6.979	347.381	7.389	348.326	7.838	348.922	8.251	349.494	8.692	349.818	9.104	349.942
5.732	343.750	6.156	345.217	6.578	346.436	6.995	347.405	7.412	348.350	7.831	348.947	8.270	349.295	8.693	349.818	9.119	350.041
5.748	343.800	6.156	345.242	6.578	346.436	6.995	347.405	7.412	348.350	7.831	348.947	8.270	349.295	8.693	349.818	9.119	350.041
5.748	343.725	6.168	345.093	6.588	346.311	6.985	347.331	7.415	348.400	7.838	348.922	8.273	349.395	8.693	349.793	9.113	349.987
5.754	343.924	6.171	345.192	6.588	346.411	6.985	347.331	7.415	348.400	7.838	348.922	8.273	349.395	8.693	349.793	9.113	349.987
5.754	343.800	6.174	345.217	6.581	346.535	7.001	347.530	7.418	348.400	7.854	348.972	8.287	349.445	8.706	349.743	9.129	349.942
5.735	343.675	6.171	345.192	6.581	346.535	7.001	347.530	7.418	348.400	7.854	348.972	8.287	349.445	8.706	349.743	9.129	349.942
5.761	343.849	6.171	345.167	6.604	346.535	7.001	347.530	7.446	348.350	7.857	349.047	8.292	349.494	8.715	349.768	9.135	349.992
5.761	343.849	6.171	345.167	6.604	346.535	7.001	347.530	7.446	348.350	7.857	349.047	8.292	349.494	8.715	349.768	9.135	349.992
5.786	343.824	6.187	345.242	6.610	346.510	7.020	347.430	7.431	348.425	7.857	349.047	8.292	349.494	8.715	349.768	9.135	349.992
5.786	343.824	6.187	345.242	6.610	346.510	7.020	347.430	7.431	348.425	7.857	349.047	8.292	349.494	8.715	349.768	9.135	349.992
5.773	343.849	6.187	345.207	6.610	346.535	7.027	347.480	7.440	348.435	7.865	349.047	8.324	349.494	8.725	349.793	9.145	350.017
5.780	343.849	6.193	345.242	6.607	346.486	7.027	347.480	7.440	348.435	7.865	349.047	8.324	349.494	8.725	349.793	9.145	350.017
5.792	343.874	6.199	345.265	6.629	346.535	7.039	347.530	7.449	348.500	7.879	349.047	8.314	349.519	8.737	349.793	9.160	349.942
5.789	343.999	6.212	345.341	6.619	346.590	7.042	347.654	7.449	348.500	7.879	349.047	8.314	349.519	8.737	349.793	9.160	349.942
5.799	343.949	6.209	345.966	6.629	346.610	7.039	347.655	7.465	348.375	7.895	349.022	8.308	349.445	8.744	349.818	9.173	349.992
5.789	343.949	6.212	345.966	6.632	346.585	7.039	347.655	7.465	348.375	7.895	349.022	8.308	349.445	8.744	349.818	9.173	349.992
5.805	343.775	6.225	345.366	6.638	346.659	7.071	347.629	7.462	348.450	7.901	349.121	8.324	349.494	8.747	349.818	9.192	350.091
5.811	344.023	6.237	345.419	6.638	346.610	7.061	347.629	7.465	348.450	7.901	349.121	8.324	349.494	8.747	349.818	9.192	350.091
5.818	344.048	6.225	345.391	6.645	346.610	7.061	347.629	7.465	348.450	7.901	349.121	8.324	349.494	8.747	349.818	9.192	350.091
5.821	344.048	6.231	345.365	6.654	346.535	7.071	347.629	7.487	348.450	7.906	349.096	8.340	349.494	8.768	349.768	9.208	349.992
5.824	344.123	6.244	345.441	6.664	346.659	7.065	347.679	7.497	348.500	7.920	349.121	8.327	349.469	8.772	349.842	9.208	349.992
5.824	344.048	6.237	345.441	6.654	346.634	7.068	347.694	7.491	348.549	7.917	349.096	8.343	349.519	8.772	349.768	9.211	350.017
5.814	344.073	6.247	345.441	6.654	346.634	7.077	347.629	7.484	348.524	7.917	349.096	8.343	349.519	8.772	349.768	9.211	350.017
5.830	344.173	6.253	345.416	6.654	346.759	7.085	347.654	7.487	348.475	7.926	349.022	8.362	349.469	8.788	349.542	9.220	349.967
5.843	344.073	6.253	345.515	6.676	346.709	7.086	347.679	7.506	348.400	7.942	349.072	8.362	349.519	8.791	349.867	9.217	350.017
5.849	344.148	6.266	345.515	6.676	346.709	7.093	347.654	7.509	348.674	7.932	349.121	8.368	349.569	8.792	349.818	9.198	349.942
5.845	344.148	6.269	345.491	6.676	346.709	7.093	347.654	7.509	348.674	7.932	349.121	8.368	349.569	8.792	349.818	9.198	349.942
5.855	344.073	6.272	345.515	6.678	346.734	7.093	347.679	7.509	348.574	7.955	349.096	8.371	349.569	8.794	349.793	9.242	349.992
5.871	344.123	6.266	345.515	6.682	346.709	7.093	347.704	7.513	348.624	7.955	349.072	8.384	349.494	8.791	349.842	9.242	349.992
5.859	344.222	6.269	345.540	6.692	346.709	7.112	347.704	7.522	348.649	7.970	349.072	8.387	349.504	8.801	349.842	9.236	349.967
5.862	344.222	6.278	345.565	6.692	346.883	7.115	347.729	7.535	348.549	7.965	349.121	8.403	349.594	8.810	349.892	9.249	350.041
5.865	344.222	6.285	345.615	6.705	346.769	7.109	347.704	7.535	348.549	7.965	349.121	8.403	349.594	8.810	349.892	9.249	350.041
5.887	344.247	6.285	345.605	6.720	346.759	7.121	347.729	7.538	348.723	7.951	349.096	8.406	349.594	8.832	349.892	9.255	350.066
5.874	344.173	6.297	345.590	6.711	346.659	7.124	347.679	7.544	348.698	7.973	349.096	8.406	349.594	8.832	349.892	9.255	350.066
5.881	344.297	6.301	345.615	6.698	346.759	7.124	347.679	7.544	348.698	7.973	349.096	8.406	349.594	8.832	349.892	9.255	350.066
5.887	344.247	6.291	345.590	6.708	346.983	7.115	347.754	7.541	348.599	7.977	349.096	8.406	349.594	8.832	349.892	9.255	350.066
5.881	344.272	6.304	345.640	6.717	346.809	7.137	347.853	7.573	348.624	7.996	349.146	8.415	349.594	8.842	349.892	9.268	349.967
5.890	344.222	6.313	345.665	6.736	346.784	7.137	347.704	7.573	348.599	7.990	349.072	8.415	349.594	8.842	349.892	9.271	350.041
5.900	344.247	6.301	345.615	6.720	346.883	7.150	347.828	7.563	348.599	7.986	349.047	8.419	349.494	8.845	349.892	9.271	350.041
5.903	344.436	6.319	345.714	6.733	346.883	7.140	347.754	7.573	348.500	8.002	349.121	8.425	349.718	8.857	349.942	9.271	349.992

[Table 6] - 2

9.527	350.041	9.968	349.967	10.404	349.644	10.827	349.270	11.247	348.674	11.708	347.754	12.165	346.535	12.601	344.794	13.049	342.457
9.514	350.091	9.959	350.017	10.404	349.619	10.824	349.320	11.272	348.748	11.701	347.803	12.162	346.535	12.588	344.789	13.032	342.506
9.523	350.216	9.965	349.892	10.404	349.743	10.830	349.295	11.275	348.674	11.711	348.002	12.162	346.485	12.607	344.745	13.062	342.482
9.527	350.061	9.965	350.041	10.388	349.668	10.843	349.235	11.275	348.649	11.720	347.829	12.162	346.510	12.607	344.695	13.069	342.288
9.530	350.017	9.978	349.992	10.410	349.768	10.849	349.345	11.281	348.669	11.714	347.729	12.162	346.485	12.607	344.720	13.069	342.382
9.539	350.066	9.978	349.967	10.388	349.644	10.852	349.295	11.281	348.669	11.733	347.764	12.175	346.485	12.617	344.789	13.071	342.283
9.549	349.917	9.977	349.818	10.423	349.683	10.859	349.295	11.301	348.649	11.727	347.679	12.175	346.411	12.617	344.819	13.084	342.332
9.549	350.066	9.977	349.942	10.420	349.718	10.859	349.221	11.301	348.674	11.739	347.803	12.172	346.436	12.636	344.670	13.084	342.332
9.545	350.066	9.994	349.793	10.420	349.743	10.865	349.295	11.319	348.624	11.742	347.853	12.203	346.510	12.626	344.670	13.084	342.387
9.571	350.066	9.991	349.892	10.429	349.693	10.881	349.295	11.313	348.549	11.752	347.754	12.185	346.411	12.614	344.471	13.093	342.258
9.549	349.962	9.997	349.992	10.429	349.718	10.874	349.270	11.323	348.569	11.752	347.679	12.203	346.411	12.626	344.670	13.084	342.298
9.571	350.061	10.006	349.942	10.432	349.644	10.871	349.295	11.332	348.649	11.755	347.729	12.191	346.411	12.645	344.645	13.093	342.298
9.580	350.141	10.013	350.017	10.442	349.892	10.893	349.246	11.319	348.574	11.755	347.754	12.206	346.396	12.648	344.595	13.109	342.283
9.571	350.285	10.013	349.942	10.448	349.803	10.890	349.270	11.332	348.674	11.746	347.729	12.213	346.391	12.658	344.745	13.106	342.283
9.590	350.041	10.022	349.917	10.448	348.718	10.884	349.570	11.345	348.624	11.768	347.754	12.203	346.336	12.639	344.570	13.106	342.283
9.586	350.041	10.022	349.867	10.458	348.743	10.897	349.270	11.351	348.574	11.771	347.853	12.219	346.291	12.674	344.670	13.119	342.158
9.580	350.091	10.022	349.942	10.461	349.663	10.909	349.246	11.342	348.549	11.787	347.729	12.210	346.311	12.668	344.471	13.122	342.004
9.589	350.017	10.032	349.892	10.461	349.644	10.900	349.246	11.342	348.475	11.796	347.654	12.225	346.296	12.670	344.372	13.134	342.009
9.602	350.017	10.041	349.942	10.461	349.668	10.915	349.221	11.342	348.475	11.802	347.754	12.235	346.187	12.677	344.446	13.144	342.059
9.615	350.141	10.045	349.967	10.470	349.668	10.912	349.246	11.357	348.549	11.787	347.654	12.235	346.237	12.680	344.421	13.131	342.009
9.596	350.017	10.047	350.116	10.480	349.568	10.928	349.146	11.357	348.549	11.806	347.604	12.241	346.187	12.686	344.471	13.134	341.934
9.612	350.066	10.041	349.942	10.486	349.644	10.912	349.196	11.351	348.475	11.806	347.654	12.246	346.237	12.702	344.222	13.147	341.984
9.618	350.166	10.057	349.892	10.496	349.743	10.944	349.221	11.367	348.450	11.796	347.604	12.251	346.187	12.693	344.496	13.153	342.059
9.624	350.041	10.061	349.942	10.502	349.430	10.941	349.221	11.370	348.524	11.806	347.555	12.257	346.237	12.702	344.297	13.138	341.835
9.615	350.091	10.057	349.967	10.496	349.619	10.931	349.121	11.370	348.524	11.799	347.555	12.257	346.237	12.702	344.297	13.138	341.835
9.615	349.942	10.073	349.917	10.490	349.594	10.941	348.972	11.389	348.425	11.809	347.580	12.266	346.963	12.705	344.222	13.150	341.810
9.621	349.942	10.066	349.942	10.515	349.644	10.944	349.146	11.383	348.350	11.818	347.604	12.254	346.187	12.715	344.272	13.172	341.855
9.640	350.041	10.086	349.942	10.505	349.594	10.938	349.171	11.393	348.524	11.809	347.480	12.285	346.187	12.711	344.222	13.172	341.855
9.643	350.141	10.088	349.992	10.508	349.619	10.956	349.022	11.396	348.524	11.831	347.530	12.279	346.013	12.730	344.372	13.169	341.760
9.646	350.066	10.085	349.867	10.521	349.569	10.966	349.196	11.402	348.500	11.831	347.530	12.282	346.112	12.715	344.173	13.179	341.860
9.660	350.017	10.095	349.942	10.524	349.594	10.969	349.146	11.385	348.500	11.834	347.505	12.285	346.038	12.740	344.222	13.195	341.886
9.650	350.017	10.101	349.867	10.527	349.644	10.975	349.196	11.411	348.425	11.834	347.405	12.285	346.038	12.740	344.148	13.198	341.781
9.665	350.041	10.101	349.743	10.540	349.544	10.982	349.072	11.417	348.475	11.834	347.405	12.285	346.063	12.740	344.123	13.207	341.781
9.665	350.041	10.095	350.041	10.550	349.619	10.979	349.121	11.411	348.398	11.850	347.430	12.288	346.067	12.740	344.098	13.210	341.661
9.685	350.066	10.101	349.892	10.540	349.594	10.975	349.121	11.424	348.425	11.862	347.291	12.317	346.038	12.743	344.098	13.207	341.537
9.689	350.066	10.110	349.892	10.549	349.594	10.975	349.096	11.427	348.375	11.862	347.291	12.317	346.038	12.743	344.098	13.207	341.537
9.681	350.041	10.107	349.892	10.556	349.619	11.007	349.096	11.424	348.400	11.853	347.455	12.323	346.067	12.753	343.974	13.204	341.581
9.669	350.061	10.117	349.867	10.543	349.768	10.997	349.047	11.430	348.375	11.866	347.356	12.330	346.988	12.756	344.048	13.226	341.487
9.678	350.061	10.120	350.091	10.556	349.668	11.004	348.922	11.443	348.301	11.872	347.580	12.307	346.963	12.771	344.048	13.229	341.482
9.681	350.061	10.120	349.892	10.574	349.644	10.994	349.096	11.443	348.301	11.884	347.381	12.314	346.789	12.762	344.023	13.229	341.512
9.697	350.066	10.123	349.867	10.571	349.569	11.013	349.072	11.452	348.350	11.891	347.430	12.326	346.864	12.781	343.974	13.226	341.487
9.694	350.116	10.136	349.867	10.568	349.619	11.023	349.047	11.443	348.375	11.875	347.405	12.333	346.888	12.775	343.949	13.226	341.563
9.700	350.041	10.158	349.819	10.574	349.544	11.023	349.146	11.461	348.400	11.891	347.356	12.330	346.864	12.797	344.222	13.220	341.437
9.713	350.116	10.136	349.842	10.584	349.668	11.029	349.121	11.461	348.375	11.903	347.331	12.345	346.888	12.797	343.949	13.245	341.363
9.706	350.066	10.139	349.818	10.583	349.494	11.026	348.972	11.458	348.326	11.900	347.291	12.355	346.738	12.790	340.849	13.242	341.313

[Table 7]—1

tensile test: table 5, (1) Strain (%) (2) Stress (MPa)									
(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
13.248	341.338	13.731	338.105	14.189	334.375	14.656	329.898	15.155	324.726
13.258	341.363	13.722	338.065	14.186	334.350	14.681	329.894	15.161	324.701
13.268	341.213	13.731	338.030	14.201	334.275	14.694	329.774	15.170	324.726
13.261	341.064	13.744	338.055	14.205	334.161	14.688	329.675	15.167	324.651
13.285	341.213	13.734	338.030	14.211	334.376	14.678	329.724	15.186	324.577
13.270	341.139	13.737	337.956	14.223	334.101	14.678	329.690	15.186	324.477
13.273	341.089	13.744	337.956	14.208	334.126	14.700	329.600	15.180	324.676
13.289	341.114	13.756	337.956	14.217	334.200	14.691	329.575	15.193	324.427
13.299	341.164	13.763	337.906	14.217	334.101	14.713	329.426	15.199	324.228
13.290	341.039	13.769	337.831	14.230	334.002	14.716	329.426	15.211	324.263
13.286	341.014	13.769	337.806	14.236	333.927	14.732	329.351	15.196	324.204
13.292	340.965	13.775	337.806	14.246	333.902	14.729	329.326	15.211	324.228
13.302	340.989	13.772	337.757	14.239	333.852	14.713	329.326	15.215	324.303
13.318	340.940	13.778	337.682	14.239	333.753	14.741	329.127	15.211	324.104
13.324	340.840	13.778	337.657	14.246	333.678	14.738	329.202	15.230	323.980
13.343	340.840	13.801	337.583	14.265	333.703	14.732	329.152	15.234	323.930
13.353	340.892	13.778	337.508	14.282	333.653	14.741	329.127	15.227	323.880
13.327	340.815	13.801	337.458	14.288	333.603	14.761	329.028	15.237	323.831
13.321	340.766	13.804	337.483	14.277	333.554	14.767	329.028	15.246	323.781
13.349	340.716	13.807	337.408	14.280	333.529	14.764	328.904	15.253	323.706
13.340	340.641	13.801	337.384	14.274	333.529	14.763	328.928	15.249	323.706
13.355	340.641	13.813	337.284	14.290	333.454	14.776	328.854	15.275	323.532
13.352	340.691	13.823	337.359	14.302	333.430	14.776	328.829	15.281	323.507
13.355	340.592	13.829	337.309	14.296	333.355	14.779	328.730	15.275	323.532
13.362	340.641	13.810	337.284	14.321	333.380	14.798	328.606	15.281	323.457
13.371	340.567	13.823	337.234	14.321	333.231	14.798	328.580	15.297	323.234
13.374	340.592	13.858	337.259	14.316	333.231	14.798	328.555	15.303	323.333
13.368	340.417	13.848	337.135	14.312	333.057	14.792	328.481	15.303	323.109
13.378	340.467	13.854	337.160	14.315	333.156	14.792	328.481	15.313	323.234
13.368	340.442	13.867	337.135	14.328	333.081	14.811	328.456	15.313	323.109
13.390	340.417	13.845	337.011	14.328	332.952	14.804	328.431	15.313	323.109
13.383	340.442	13.860	337.059	14.324	332.932	14.826	328.357	15.322	323.109
13.396	340.243	13.867	336.986	14.334	332.957	14.823	328.307	15.313	323.036
13.422	340.243	13.870	336.986	14.350	332.883	14.836	328.207	15.325	322.886
13.403	340.318	13.883	336.911	14.362	332.957	14.830	328.232	15.331	322.886
13.409	340.268	13.873	336.936	14.347	332.858	14.836	328.183	15.335	322.940
13.422	340.268	13.876	336.887	14.353	332.833	14.848	328.183	15.350	322.761
13.409	340.094	13.883	336.886	14.359	332.706	14.848	328.183	15.357	322.712
13.434	340.318	13.898	336.812	14.356	332.609	14.852	327.785	15.357	322.662
13.428	340.020	13.895	336.712	14.359	332.684	14.855	328.008	15.360	322.637
13.409	340.169	13.905	336.712	14.372	332.609	14.874	327.934	15.357	322.488
13.438	340.094	13.902	336.638	14.388	332.733	14.864	327.859	15.369	322.513
13.441	340.020	13.914	336.657	14.397	332.634	14.871	327.785	15.366	322.488
13.453	340.069	13.914	336.586	14.388	332.580	14.880	327.829	15.376	322.413
13.472	339.895	13.914	336.538	14.388	332.486	14.880	327.710	15.379	322.388
13.466	339.945	13.908	336.613	14.400	332.410	14.899	327.511	15.382	322.289
13.463	339.870	13.911	336.638	14.407	332.311	14.896	327.685	15.391	322.239
13.472	339.920	13.920	336.488	14.413	332.360	14.912	327.511	15.385	322.140
13.482	339.920	13.946	336.314	14.425	332.261	14.921	327.561	15.391	322.040
13.472	339.870	13.949	336.389	14.419	332.261	14.902	327.486	15.407	322.040
13.482	339.721	13.943	336.289	14.429	332.236	14.927	327.436	15.414	321.965

[Table 7]-2

13.485	339.821	13.933	336.339	14.444	332.136	14.924	327.287	15.417	321.891	15.919	315.674	16.461	308.497	17.020	287.200
13.488	339.771	13.949	336.240	14.432	332.261	14.924	327.287	15.426	321.866	15.934	315.574	16.465	308.412		
13.497	339.721	13.958	336.215	14.435	332.087	14.918	327.213	15.426	321.791	15.941	315.525	16.449	308.213		
13.504	339.597	13.955	336.165	14.441	332.062	14.934	327.138	15.429	321.742	15.944	315.500	16.480	308.238		
13.497	339.472	13.977	335.094	14.457	332.037	14.946	327.138	15.429	321.617	15.947	315.475	16.484	308.164		
13.510	339.622	13.977	336.068	14.460	331.888	14.946	327.113	15.429	321.617	15.944	315.326	16.474	308.039		
13.526	339.622	13.984	336.090	14.469	331.863	14.963	327.063	15.439	321.443	15.963	315.301	16.477	307.890		
13.523	339.572	13.971	336.041	14.467	331.838	14.943	326.964	15.445	321.384	15.963	315.226	16.487	307.841		
13.523	339.487	13.990	335.966	14.476	331.788	14.965	326.889	15.458	321.344	15.988	315.102	16.496	307.716		
13.539	339.472	13.990	335.892	14.467	331.714	14.952	326.939	15.458	321.319	15.963	315.077	16.506	307.641		
13.548	339.322	13.999	335.892	14.489	331.739	14.952	326.815	15.458	321.319	15.963	315.077	16.506	307.641		
13.532	339.398	14.006	335.867	14.489	331.614	14.978	326.815	15.464	321.145	15.988	315.002	16.499	307.741		
13.567	339.249	14.006	335.892	14.476	331.639	14.965	326.765	15.463	321.145	15.982	314.903	16.509	307.467		
13.551	339.245	14.025	335.817	14.492	331.540	14.981	326.666	15.480	321.244	15.985	314.803	16.521	307.398		
13.554	339.249	14.015	335.767	14.492	331.515	14.991	326.616	15.489	321.095	15.994	314.754	16.534	307.418		
13.551	339.274	14.018	335.742	14.511	331.415	14.981	326.566	15.483	320.971	16.007	314.605	16.534	307.244		
13.554	339.274	14.025	335.717	14.508	331.415	15.009	326.591	15.492	320.971	16.023	314.605	16.534	307.119		
13.561	339.396	14.031	335.593	14.504	331.315	15.003	326.442	15.496	320.895	16.013	314.530	16.544	307.070		
13.560	339.174	14.034	335.568	14.527	331.341	15.009	326.342	15.518	320.822	16.016	314.455	16.528	306.970		
13.580	339.174	14.030	335.519	14.523	331.191	15.003	326.392	15.524	320.822	16.035	314.455	16.544	306.896		
13.589	339.124	14.047	335.469	14.527	331.191	15.019	326.342	15.518	320.797	16.026	314.381	16.550	306.821		
13.592	339.050	14.047	335.469	14.533	331.142	15.022	326.392	15.518	320.623	16.042	314.256	16.559	306.672		
13.605	339.075	14.056	335.469	14.533	331.042	15.019	326.318	15.527	320.573	16.029	314.182	16.559	306.647		
13.595	338.950	14.072	335.384	14.536	331.092	15.038	326.193	15.530	320.473	16.051	314.157	16.591	306.697		
13.595	338.925	14.078	335.320	14.536	330.993	15.036	326.218	15.530	320.399	16.054	314.157	16.578	306.647		
13.614	338.901	14.063	335.344	14.542	330.906	15.041	326.094	15.549	320.398	16.042	313.983	16.588	306.648		
13.598	338.875	14.081	335.245	14.571	330.993	15.032	326.044	15.552	320.349	16.064	313.908	16.594	306.524		
13.614	338.925	14.075	335.270	14.571	330.918	15.051	325.969	15.552	320.299	16.064	313.858	16.597	306.249		
13.617	338.876	14.094	335.121	14.571	330.794	15.047	325.919	15.568	320.200	16.051	313.759	16.597	306.100		
13.626	338.826	14.094	335.146	14.568	330.744	15.040	325.795	15.552	320.176	16.073	313.680	16.600	306.076		
13.633	338.776	14.097	335.146	14.577	330.669	15.073	325.820	15.559	320.125	16.067	313.684	16.619	305.876		
13.649	338.727	14.104	335.046	14.583	330.619	15.063	325.696	15.568	320.100	16.105	313.535	16.619	305.901		
13.649	338.727	14.113	335.046	14.590	330.619	15.065	325.721	15.565	320.076	16.089	313.436	16.613	305.927		
13.658	338.627	14.113	334.947	14.596	330.545	15.079	325.621	15.581	319.926	16.111	313.461	16.632	305.792		
13.646	338.627	14.113	334.971	14.596	330.545	15.082	325.646	15.584	319.901	16.098	313.466	16.619	305.563		
13.652	338.627	14.110	334.872	14.609	330.520	15.088	325.571	15.580	319.827	16.082	313.287	16.626	305.428		
13.662	338.776	14.132	334.872	14.590	330.396	15.092	325.447	15.587	319.752	16.105	313.252	16.657	305.379		
13.640	338.677	14.135	334.797	14.602	330.396	15.095	325.497	15.609	319.727	16.121	313.113	16.654	305.329		
13.668	338.478	14.129	334.746	14.618	330.346	15.101	325.422	15.620	319.653	16.114	313.013	16.660	305.304		
13.677	338.428	14.138	334.797	14.605	330.296	15.098	325.372	15.616	319.553	16.124	312.988	16.657	305.180		
13.677	338.453	14.146	334.648	14.624	330.296	15.120	325.399	15.612	319.504	16.136	312.989	16.667	305.030		
13.668	338.353	14.148	334.648	14.612	330.122	15.123	325.273	15.625	319.379	16.140	312.914	16.662	304.956		
13.696	338.378	14.167	334.598	14.637	330.197	15.117	325.273	15.622	319.379	16.146	312.764	16.673	304.881		
13.693	338.378	14.157	334.598	14.637	330.122	15.136	325.099	15.628	319.305	16.152	312.690	16.679	304.732		
13.677	338.254	14.164	334.549	14.659	330.072	15.133	325.124	15.644	319.239	16.168	312.690	16.688	304.483		
13.699	338.279	14.160	334.574	14.643	330.023	15.136	325.049	15.657	319.255	16.168	312.541	16.701	304.483		
13.696	338.229	14.173	334.499	14.669	329.948	15.152	324.950	15.653	319.131	16.165	312.491	16.689	304.458		
13.718	338.229	14.179	334.389	14.656	329.898	15.155	324.900	16.644	319.081	16.171	312.491	16.708	304.384		
13.722	338.175	14.179	334.389	14.659	329.824	15.158	324.850	15.653	319.006	16.177	312.317	16.701	304.236		

[Table 1]

		compression test table 1 (1) Strain (%) (2) Stress (MPa)											
(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
0.000	2.554	0.002	12.506	0.403	95.911	0.614	145.203	0.818	191.776	1.021	234.628	1.438	246.453
0.005	2.532	-0.005	12.816	0.407	96.359	0.617	145.665	0.821	192.216	1.025	235.046	1.448	246.943
0.010	2.422	-0.016	12.948	0.402	96.912	0.613	146.128	0.819	192.679	1.027	235.431	1.443	246.255
0.017	2.576	-0.008	13.146	0.401	97.895	0.619	146.585	0.821	193.075	1.024	235.707	1.461	246.188
0.025	2.444	-0.014	13.322	0.412	97.859	0.625	147.273	0.822	193.560	1.024	236.163	1.460	246.122
-0.002	2.598	-0.016	13.454	0.401	98.265	0.624	147.471	0.825	194.022	1.019	236.543	1.472	245.946
0.009	2.797	-0.010	13.909	0.408	98.828	0.622	148.021	0.828	194.441	1.029	236.918	1.458	245.946
0.003	3.053	-0.013	13.785	0.408	98.828	0.622	148.021	0.828	194.441	1.029	236.918	1.458	245.946
-0.001	3.545	-0.013	13.961	0.417	99.797	0.636	148.594	0.829	195.343	1.045	237.733	1.479	245.982
0.010	3.721	-0.019	14.159	0.417	99.797	0.636	148.594	0.829	195.343	1.045	237.733	1.479	245.982
0.003	4.228	-0.025	14.291	0.421	100.832	0.639	150.003	0.842	196.224	1.036	238.393	1.500	245.694
0.000	4.470	-0.016	14.401	0.419	100.832	0.639	150.003	0.842	196.224	1.036	238.393	1.500	245.694
0.011	4.426	-0.018	14.580	0.427	101.775	0.648	151.969	0.850	197.567	1.053	239.935	1.513	245.418
0.010	4.766	-0.018	14.798	0.435	102.965	0.648	151.969	0.850	197.567	1.053	239.935	1.513	245.418
0.020	4.806	-0.013	14.798	0.435	102.965	0.648	151.969	0.850	197.567	1.053	239.935	1.513	245.418
0.008	4.778	-0.021	15.106	0.441	103.210	0.653	152.436	0.846	198.514	1.054	240.255	1.524	245.242
0.009	4.800	-0.020	15.282	0.441	103.210	0.653	152.436	0.846	198.514	1.054	240.255	1.524	245.242
0.013	4.778	-0.016	15.348	0.442	104.289	0.652	153.228	0.853	199.263	1.055	240.926	1.535	245.264
0.008	4.844	-0.007	15.530	0.434	104.817	0.655	153.557	0.847	200.258	1.054	241.740	1.544	245.021
0.010	4.999	0.010	15.635	0.438	105.358	0.659	154.826	0.850	200.946	1.078	242.027	1.553	245.043
0.014	5.065	0.047	15.480	0.443	105.764	0.659	154.826	0.850	200.946	1.078	242.027	1.553	245.043
0.019	4.955	0.046	15.701	0.443	105.357	0.657	155.112	0.858	201.003	1.078	242.027	1.553	245.043
0.014	4.712	0.049	15.699	0.446	107.195	0.666	156.169	0.854	202.038	1.079	242.731	1.559	244.977
0.013	4.911	0.052	15.075	0.454	107.768	0.672	156.631	0.852	202.858	1.079	242.731	1.559	244.977
0.020	4.996	0.052	15.273	0.457	108.252	0.663	157.160	0.856	202.896	1.079	242.731	1.559	244.977
0.010	5.043	0.052	15.361	0.462	108.759	0.666	157.160	0.857	203.381	1.095	243.744	1.573	244.823
0.015	5.087	0.044	15.714	0.462	108.759	0.666	157.160	0.857	203.381	1.095	243.744	1.573	244.823
0.015	5.085	0.053	15.912	0.464	109.243	0.676	158.085	0.871	203.799	1.094	244.405	1.586	244.623
0.026	5.131	0.043	17.132	0.464	109.243	0.676	158.085	0.871	203.799	1.094	244.405	1.586	244.623
0.026	5.043	0.048	17.264	0.474	110.234	0.681	159.032	0.869	204.599	1.099	244.999	1.597	244.691
0.015	5.175	0.050	17.662	0.474	110.234	0.681	159.032	0.869	204.599	1.099	244.999	1.597	244.691
0.019	5.197	0.051	17.837	0.476	111.225	0.683	159.658	0.876	205.407	1.097	245.690	1.613	244.559
0.017	5.175	0.038	18.167	0.475	111.854	0.683	159.658	0.876	205.407	1.097	245.690	1.613	244.559
0.016	5.131	0.043	18.519	0.479	112.260	0.687	160.947	0.880	205.979	1.101	245.968	1.607	244.537
0.012	5.307	0.058	18.627	0.478	112.260	0.687	160.947	0.880	205.979	1.101	245.968	1.607	244.537
0.022	5.263	0.063	19.092	0.478	112.260	0.687	160.947	0.880	205.979	1.101	245.968	1.607	244.537
0.015	5.197	0.059	19.268	0.483	113.273	0.696	162.489	0.901	207.256	1.115	246.029	1.622	244.471
0.020	5.439	0.055	19.774	0.483	113.273	0.696	162.489	0.901	207.256	1.115	246.029	1.622	244.471
0.024	5.439	0.053	20.043	0.490	114.704	0.698	163.304	0.886	208.600	1.112	247.774	1.631	244.427
0.017	5.483	0.059	20.501	0.488	115.673	0.702	164.272	0.886	208.600	1.112	247.774	1.631	244.427
0.026	5.605	0.055	20.853	0.492	115.673	0.702	164.272	0.886	208.600	1.112	247.774	1.631	244.427
0.024	5.605	0.063	21.228	0.494	116.224	0.697	165.043	0.896	210.229	1.124	248.575	1.674	244.207
0.022	5.615	0.061	21.646	0.496	116.224	0.697	165.043	0.896	210.229	1.124	248.575	1.674	244.207
0.025	5.615	0.067	21.908	0.503	117.743	0.699	166.276	0.904	210.758	1.134	249.117	1.688	244.118
0.034	5.659	0.053	22.373	0.503	117.743	0.699	166.276	0.904	210.758	1.134	249.117	1.688	244.118
0.019	5.703	0.065	22.835	0.497	118.074	0.707	166.553	0.913	211.638	1.133	249.624	1.689	244.141
0.029	5.747	0.062	23.188	0.511	118.776	0.708	167.025	0.914	212.935	1.138	249.756	1.698	244.118
0.028	5.747	0.065	23.496	0.514	119.087	0.712	167.531	0.909	212.497	1.146	250.064	1.686	244.008
0.035	5.879	0.073	23.980	0.506	119.483	0.716	167.966	0.909	212.497	1.146	250.064	1.686	244.008
0.025	5.791	0.072	24.311	0.500	120.166	0.724	168.456	0.914	213.378	1.151	250.615	1.706	244.030
0.024	5.879	0.074	24.985	0.500	120.166	0.724	168.456	0.914	213.378	1.151	250.615	1.706	244.030
0.028	5.980	0.073	25.125	0.512	121.024	0.715	168.941	0.927	213.664	1.148	250.769	1.711	243.886
0.029	6.012	0.084	25.522	0.512	121.024	0.715	168.941	0.927	213.664	1.148	250.769	1.711	243.886
0.031	6.034	0.073	25.941	0.519	121.663	0.717	169.844	0.936	214.743	1.162	251.275	1.723	244.008
				0.512	122.213	0.721	170.218	0.930	215.140	1.170	251.461	1.729	243.964

[Table] 2

0.025	6.144	0.079	26.358	0.204	73.174	0.514	122.632	0.722	170.747	0.928	215.558	1.178	251.672	1.724	243.942	2.233	244.955
0.021	6.144	0.077	26.755	0.209	73.592	0.516	123.072	0.714	171.187	0.931	215.976	1.177	251.848	1.736	243.810	2.243	244.977
0.015	6.210	0.088	27.136	0.313	74.089	0.821	123.645	0.720	171.627	0.935	216.329	1.177	252.046	1.736	243.920	2.254	244.999
0.023	6.188	0.088	27.636	0.305	74.605	0.827	124.129	0.734	172.156	0.936	216.879	1.175	252.134	1.746	243.920	2.251	244.977
0.024	6.364	0.096	28.010	0.301	75.156	0.928	124.636	0.729	172.640	0.921	217.254	1.183	252.200	1.755	243.854	2.263	245.043
0.033	6.386	0.084	28.428	0.317	75.640	0.928	125.120	0.728	173.016	0.959	217.738	1.192	253.508	1.761	243.920	2.268	245.043
0.029	6.320	0.094	28.737	0.321	76.125	0.927	125.693	0.733	173.621	0.940	218.002	1.189	253.640	1.758	243.876	2.265	245.176
0.024	6.006	0.107	29.265	0.316	76.499	0.929	126.133	0.735	173.983	0.932	218.443	1.205	252.751	1.767	243.788	2.267	245.176
0.031	6.116	0.101	29.705	0.319	77.116	0.939	126.640	0.739	174.490	0.941	219.412	1.204	252.971	1.781	243.852	2.289	245.176
0.032	6.936	0.109	30.168	0.321	77.644	0.934	127.124	0.738	174.908	0.945	220.270	1.210	253.037	1.784	243.888	2.292	245.264
0.028	6.804	0.106	30.554	0.316	78.084	0.946	127.630	0.743	176.266	0.945	220.689	1.221	253.103	1.803	243.744	2.290	245.242
0.036	7.289	0.111	31.467	0.333	79.597	0.954	128.577	0.743	176.648	0.952	221.063	1.235	253.125	1.795	243.810	2.290	245.242
0.029	7.421	0.111	31.864	0.330	79.582	0.947	129.040	0.744	177.220	0.953	221.504	1.223	253.015	1.813	243.832	2.301	245.252
0.028	7.619	0.104	32.304	0.345	80.000	0.952	129.546	0.753	178.189	0.958	222.428	1.246	252.971	1.822	243.788	2.312	245.374
0.023	7.751	0.105	32.744	0.330	80.595	0.964	130.637	0.752	178.584	0.958	222.803	1.246	252.971	1.822	243.788	2.312	245.374
0.024	7.961	0.120	33.515	0.340	81.057	0.952	130.637	0.763	179.092	0.962	223.243	1.252	252.963	1.831	243.722	2.325	245.462
0.016	7.993	0.126	34.044	0.342	82.070	0.955	131.506	0.771	179.533	0.967	223.926	1.253	252.484	1.850	243.788	2.337	245.462
0.013	8.214	0.125	34.044	0.350	82.533	0.960	131.968	0.764	179.797	0.972	224.388	1.265	251.914	1.839	243.788	2.340	245.528
0.005	8.544	0.122	34.902	0.342	83.061	0.967	132.453	0.763	180.012	0.974	224.873	1.274	251.473	1.845	243.706	2.348	245.572
0.011	8.654	0.119	35.409	0.351	83.501	0.966	132.981	0.765	181.062	0.974	225.357	1.281	251.275	1.849	243.722	2.354	245.572
0.011	8.874	0.128	35.849	0.357	84.162	0.964	133.510	0.765	181.470	0.973	225.859	1.288	250.813	1.849	243.788	2.366	245.638
0.019	8.984	0.122	36.280	0.350	84.536	0.971	133.950	0.777	181.735	0.964	226.565	1.299	250.372	1.860	243.744	2.365	245.638
0.024	9.138	0.129	36.730	0.355	85.021	0.969	134.479	0.777	182.329	0.977	226.545	1.299	250.372	1.878	243.634	2.360	245.704
0.010	9.293	0.130	37.148	0.353	85.207	0.974	135.316	0.772	182.748	0.980	226.859	1.310	250.086	1.870	243.744	2.368	245.725
0.014	9.469	0.137	37.633	0.357	85.924	0.984	135.932	0.783	183.210	0.980	227.383	1.323	249.784	1.877	243.766	2.369	245.792
0.012	9.601	0.131	38.095	0.354	86.474	0.977	136.395	0.773	183.606	0.985	227.383	1.323	249.784	1.877	243.766	2.378	245.792
0.017	9.689	0.135	38.602	0.359	86.981	0.977	136.769	0.796	184.157	0.985	227.779	1.326	249.403	1.879	243.766	2.378	245.792
0.014	9.921	0.133	38.976	0.362	87.443	0.971	137.356	0.791	184.509	0.985	228.198	1.335	249.403	1.886	243.766	2.385	245.770
0.008	10.085	0.133	39.505	0.374	87.906	0.986	137.914	0.792	184.906	0.965	228.638	1.334	249.205	1.889	243.788	2.394	245.726
0.007	10.217	0.137	39.957	0.371	88.412	0.986	138.376	0.792	185.478	0.965	229.931	1.335	249.051	1.899	243.810	2.392	245.858
0.008	10.490	0.140	40.462	0.379	88.919	0.993	138.839	0.791	185.897	0.969	229.431	1.350	248.765	1.906	243.788	2.396	245.814
0.008	10.702	0.148	40.848	0.383	89.249	0.990	139.345	0.788	186.345	1.002	229.871	1.351	248.567	1.915	243.788	2.394	245.880
0.001	10.873	0.148	41.332	0.374	89.953	0.998	139.918	0.788	186.785	1.002	230.248	1.355	248.226	1.915	243.810	2.408	245.940
0.004	11.054	0.152	42.257	0.379	90.438	0.992	140.336	0.790	187.306	1.004	230.708	1.362	247.894	1.925	243.744	2.418	245.012
0.000	11.185	0.153	42.764	0.386	91.319	0.990	140.645	0.798	187.702	1.008	231.125	1.380	247.750	1.923	243.834	2.417	245.100
0.005	11.363	0.156	43.182	0.379	91.895	0.995	141.459	0.805	188.077	1.010	231.479	1.387	247.576	1.929	243.832	2.428	246.094
0.004	11.517	0.162	43.512	0.385	92.464	0.993	141.812	0.799	188.671	1.015	232.316	1.389	247.312	1.944	243.876	2.432	246.034
0.009	11.649	0.171	44.151	0.398	92.816	0.993	142.252	0.800	189.111	1.013	232.690	1.421	247.245	1.944	243.888	2.438	246.188
0.009	11.781	0.166	44.569	0.396	93.389	0.996	142.692	0.807	189.508	1.019	233.042	1.415	246.893	1.946	243.788	2.448	246.232
0.008	11.935	0.170	45.076	0.394	93.851	0.996	143.265	0.806	189.948	1.019	233.461	1.416	246.827	1.955	243.788	2.453	246.232
0.005	12.177	0.167	45.538	0.387	94.336	0.996	143.727	0.811	190.459	1.024	233.923	1.425	246.739	1.962	243.700	2.453	246.232
0.005	12.331	0.179	46.023	0.401	94.754	0.997	144.300	0.823	190.785	1.021	234.253	1.431	246.507	1.967	243.854	2.460	246.188
0.005	12.464	0.171	46.463	0.397	95.415	0.997	144.715	0.822	191.336	1.021	234.253	1.431	246.507	1.967	243.854	2.460	246.188

[Table]—1

		compression test: Table 2: (1) Strain (%) (2) Stress (MPa)											
(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
2.453	246.243	2.945	250.246	3.414	255.086	3.886	259.511	4.346	264.023	4.813	270.675	5.264	277.898
2.462	246.287	2.942	250.372	3.405	255.129	3.889	259.467	4.349	264.179	4.822	270.697	5.266	277.938
2.468	246.365	2.954	250.372	3.413	255.151	3.884	259.511	4.363	264.179	4.840	270.763	5.282	278.140
2.475	246.409	2.948	250.502	3.414	255.195	3.893	259.655	4.371	264.377	4.825	270.829	5.281	278.140
2.481	246.453	2.940	250.504	3.429	255.151	3.900	259.533	4.373	264.443	4.828	270.885	5.287	278.316
2.485	246.453	2.965	250.549	3.431	255.371	3.906	259.665	4.373	264.531	4.829	271.006	5.289	278.360
2.498	246.475	2.970	250.603	3.436	255.371	3.900	259.709	4.387	264.554	4.825	271.116	5.290	278.448
2.501	246.595	2.970	250.649	3.430	255.371	3.904	259.775	4.380	264.620	4.839	271.094	5.308	278.514
2.503	246.629	2.977	250.725	3.446	255.459	3.913	259.775	4.380	264.708	4.831	271.182	5.299	278.581
2.503	246.607	2.979	250.747	3.450	255.613	3.921	259.907	4.397	264.774	4.853	271.204	5.305	278.735
2.503	246.607	2.983	250.769	3.450	255.613	3.931	259.907	4.397	264.774	4.853	271.204	5.305	278.735
2.503	246.607	2.983	250.769	3.450	255.613	3.931	259.907	4.397	264.774	4.853	271.204	5.305	278.735
2.511	246.651	3.001	250.813	3.464	255.669	3.932	259.775	4.406	264.862	4.864	271.578	5.322	279.021
2.522	246.656	3.003	250.835	3.472	255.678	3.943	259.819	4.414	264.972	4.869	271.498	5.328	279.055
2.530	246.695	3.008	250.791	3.474	255.723	3.940	260.017	4.417	264.972	4.863	271.490	5.330	279.055
2.533	246.805	3.004	250.791	3.477	255.767	3.949	260.039	4.421	265.080	4.873	271.696	5.335	279.307
2.541	246.805	3.012	251.099	3.482	255.679	3.949	260.039	4.428	265.126	4.878	271.710	5.335	279.307
2.539	246.805	3.018	251.011	3.483	255.877	3.957	260.149	4.421	265.253	4.887	271.738	5.343	279.285
2.548	246.959	3.025	250.945	3.494	255.944	3.973	260.105	4.435	265.354	4.898	271.974	5.361	279.327
2.551	246.959	3.041	251.249	3.498	256.010	3.971	260.171	4.439	265.368	4.904	271.996	5.368	279.327
2.559	247.003	3.031	250.967	3.498	256.032	3.972	260.215	4.442	265.478	4.905	272.106	5.370	279.571
2.572	247.047	3.042	251.297	3.507	256.098	3.980	260.304	4.454	265.610	4.918	272.238	5.372	279.792
2.568	247.091	3.045	251.319	3.506	256.230	3.984	260.348	4.454	265.610	4.920	272.238	5.372	279.792
2.577	247.069	3.062	251.319	3.506	256.230	3.967	260.392	4.450	265.721	4.927	272.349	5.386	279.902
2.581	247.201	3.077	251.495	3.521	256.286	4.006	260.436	4.466	265.765	4.932	272.459	5.389	280.166
2.583	247.246	3.061	251.539	3.533	256.286	4.001	260.392	4.466	265.765	4.932	272.459	5.389	280.166
2.591	247.201	3.072	251.583	3.540	256.406	4.018	260.480	4.481	265.919	4.945	272.613	5.396	280.144
2.594	247.312	3.077	251.605	3.549	256.494	4.015	260.550	4.481	265.919	4.935	272.679	5.406	280.276
2.605	247.334	3.065	251.694	3.554	256.494	4.018	260.546	4.493	266.029	4.935	272.679	5.406	280.276
2.609	247.157	3.082	251.694	3.554	256.582	4.015	260.546	4.502	266.117	4.944	272.723	5.413	280.354
2.609	247.334	3.089	251.672	3.560	256.604	4.028	260.666	4.498	266.205	4.958	272.761	5.418	280.518
2.618	247.465	3.081	251.738	3.562	256.692	4.045	260.744	4.493	266.271	4.970	272.943	5.418	280.518
2.620	247.554	3.110	251.892	3.562	256.692	4.045	260.744	4.493	266.271	4.970	272.943	5.418	280.518
2.641	247.488	3.109	251.936	3.574	256.758	4.050	260.854	4.502	266.337	4.983	273.053	5.425	280.781
2.632	247.576	3.105	251.792	3.574	256.758	4.050	260.854	4.502	266.337	4.983	273.053	5.425	280.781
2.644	247.620	3.108	251.914	3.572	256.802	4.052	260.832	4.515	266.425	4.983	273.141	5.425	280.781
2.635	247.708	3.126	252.046	3.587	256.912	4.054	260.942	4.537	266.645	4.992	273.352	5.438	280.971
2.631	247.796	3.127	252.134	3.587	256.912	4.054	260.942	4.537	266.645	4.992	273.352	5.438	280.971
2.643	247.840	3.133	252.265	3.593	257.111	4.078	261.182	4.557	266.712	5.011	273.692	5.452	281.377
2.639	247.708	3.149	252.310	3.593	257.111	4.078	261.182	4.557	266.712	5.011	273.692	5.452	281.377
2.669	247.769	3.139	252.310	3.604	257.067	4.078	261.182	4.557	266.712	5.011	273.692	5.452	281.377
2.672	247.862	3.157	252.376	3.625	257.223	4.082	260.986	4.557	266.712	5.011	273.692	5.452	281.377
2.678	247.972	3.157	252.376	3.625	257.223	4.082	260.986	4.557	266.712	5.011	273.692	5.452	281.377
2.684	248.104	3.159	252.442	3.630	257.287	4.111	261.339	4.574	267.042	5.032	273.894	5.469	281.663
2.694	248.170	3.165	252.442	3.630	257.287	4.111	261.339	4.574	267.042	5.032	273.894	5.469	281.663
2.705	248.038	3.165	252.552	3.642	257.397	4.123	261.427	4.583	267.152	5.034	273.978	5.475	281.730
2.702	248.170	3.165	252.552	3.642	257.397	4.123	261.427	4.583	267.152	5.034	273.978	5.475	281.730
2.702	248.235	3.176	252.530	3.646	257.463	4.125	261.515	4.597	267.328	5.039	274.110	5.486	282.016
2.711	248.192	3.188	252.773	3.648	257.485	4.129	261.537	4.597	267.328	5.039	274.110	5.486	282.016
2.717	248.236	3.185	252.765	3.643	257.573	4.129	261.427	4.583	267.482	5.050	274.287	5.507	282.256
2.720	248.214	3.186	252.839	3.652	257.595	4.129	261.427	4.583	267.482	5.056	274.309	5.511	282.258

[Table]-2

2.718	248.347	3.193	262.773	3.661	267.595	4.140	261.713	4.608	267.592	5.064	274.463	5.517	282.324	5.960	291.330	6.390	301.614
2.726	248.369	3.201	262.949	3.671	267.639	4.137	261.691	4.608	267.614	5.064	274.505	5.517	282.478	5.963	291.529	6.394	301.702
2.736	248.434	3.213	262.971	3.689	267.771	4.161	261.823	4.621	267.662	5.076	274.529	5.534	282.676	5.963	291.551	6.400	301.790
2.746	248.434	3.201	262.993	3.675	267.727	4.161	261.845	4.609	267.700	5.061	274.573	5.526	282.610	5.971	291.661	6.396	301.922
2.744	248.901	3.213	263.037	3.693	267.903	4.158	261.899	4.616	267.812	5.082	274.793	5.533	282.688	5.977	291.771	6.398	302.076
2.741	248.967	3.223	263.125	3.693	267.947	4.162	261.955	4.623	267.901	5.093	274.837	5.535	282.808	5.975	291.771	6.416	302.120
2.754	248.967	3.226	263.147	3.701	267.969	4.165	262.021	4.631	267.947	5.085	274.891	5.542	282.832	5.983	291.925	6.411	302.230
2.758	248.611	3.230	263.169	3.697	267.947	4.165	262.021	4.631	267.947	5.085	274.891	5.542	282.832	5.983	291.925	6.411	302.230
2.765	248.699	3.231	263.257	3.695	267.925	4.177	262.131	4.644	268.143	5.090	274.951	5.549	283.073	5.989	292.057	6.424	302.473
2.773	248.699	3.244	263.301	3.706	268.013	4.173	262.131	4.644	268.143	5.101	275.079	5.550	283.117	5.989	292.233	6.432	302.605
2.779	248.743	3.239	263.301	3.714	268.080	4.178	262.307	4.650	268.231	5.105	275.167	5.555	283.227	5.996	292.365	6.436	302.693
2.774	248.787	3.263	263.257	3.713	268.123	4.189	262.219	4.642	268.275	5.117	275.255	5.569	283.271	6.014	292.409	6.431	302.893
2.775	248.831	3.263	263.435	3.719	268.168	4.196	262.307	4.650	268.363	5.124	275.366	5.573	283.403	6.009	292.663	6.443	302.913
2.777	248.809	3.254	263.345	3.714	268.234	4.202	262.417	4.666	268.473	5.120	275.410	5.583	283.491	6.008	292.696	6.443	302.901
2.796	248.941	3.260	263.279	3.723	268.080	4.203	262.417	4.666	268.473	5.126	275.586	5.585	283.755	6.023	292.960	6.455	303.376
2.799	248.985	3.255	263.651	3.738	268.190	4.214	262.462	4.664	268.561	5.136	275.696	5.579	283.777	6.041	293.070	6.467	303.574
2.804	249.051	3.267	263.653	3.735	268.344	4.206	262.504	4.673	268.605	5.149	275.890	5.580	284.799	6.022	293.046	6.467	303.574
2.803	249.072	3.271	263.653	3.735	268.366	4.220	262.504	4.691	268.605	5.149	275.890	5.583	284.799	6.022	293.046	6.467	303.574
2.806	248.117	3.285	263.722	3.745	268.404	4.214	262.592	4.696	268.781	5.156	275.938	5.586	284.108	6.045	293.396	6.468	303.706
2.814	249.051	3.291	263.852	3.752	268.498	4.227	262.770	4.688	268.789	5.166	275.982	5.597	284.174	6.053	293.378	6.477	303.970
2.823	249.206	3.287	263.719	3.773	268.476	4.234	262.782	4.697	268.800	5.164	276.114	5.603	284.240	6.054	293.592	6.475	304.058
2.827	249.249	3.289	263.540	3.765	268.542	4.235	262.880	4.708	268.000	5.161	276.180	5.606	284.372	6.066	293.576	6.485	304.168
2.837	249.271	3.301	264.006	3.770	268.608	4.250	262.924	4.703	268.000	5.174	276.224	5.613	284.438	6.065	293.753	6.488	304.300
2.847	249.117	3.311	263.918	3.781	268.652	4.252	262.990	4.715	268.000	5.184	276.246	5.621	284.526	6.077	293.797	6.500	304.389
2.859	249.403	3.311	263.785	3.782	268.630	4.252	263.034	4.714	268.310	5.194	276.511	5.620	284.514	6.065	293.895	6.510	304.477
2.856	249.447	3.317	264.138	3.793	268.564	4.264	263.078	4.720	268.332	5.186	276.489	5.628	284.680	6.090	293.995	6.510	304.609
2.859	249.492	3.323	264.204	3.793	268.782	4.274	263.078	4.733	268.332	5.186	276.511	5.626	284.724	6.078	294.105	6.500	304.741
2.862	249.359	3.328	264.336	3.799	268.850	4.263	263.232	4.742	268.404	5.196	276.543	5.635	284.856	6.083	294.083	6.510	304.829
2.865	249.602	3.325	264.138	3.799	268.850	4.263	263.232	4.742	268.404	5.196	276.543	5.635	284.856	6.083	294.083	6.510	304.829
2.868	249.426	3.329	264.336	3.802	268.872	4.276	263.254	4.735	268.530	5.193	276.797	5.644	285.033	6.078	294.369	6.514	305.063
2.876	249.646	3.341	264.358	3.804	268.916	4.283	263.364	4.743	268.574	5.197	276.797	5.644	285.033	6.078	294.369	6.514	305.063
2.871	249.712	3.349	264.402	3.806	268.916	4.287	263.431	4.755	268.684	5.205	276.885	5.656	285.121	6.094	294.549	6.527	305.293
2.871	249.712	3.349	264.402	3.806	268.916	4.287	263.431	4.755	268.684	5.205	276.885	5.656	285.121	6.094	294.549	6.527	305.293
2.880	249.778	3.350	264.458	3.823	268.938	4.286	263.474	4.761	268.794	5.216	276.973	5.658	285.187	6.112	294.707	6.530	305.203
2.880	249.646	3.354	264.556	3.818	268.982	4.290	263.464	4.764	268.904	5.219	277.119	5.661	285.385	6.112	294.839	6.539	305.534
2.886	249.646	3.354	264.556	3.818	268.982	4.290	263.464	4.764	268.904	5.219	277.119	5.661	285.385	6.112	294.839	6.539	305.534
2.897	249.822	3.359	264.446	3.822	269.070	4.302	263.607	4.764	268.904	5.225	277.193	5.676	285.420	6.114	294.722	6.538	305.644
2.897	249.965	3.367	264.600	3.832	269.070	4.306	263.651	4.768	268.993	5.232	277.324	5.672	285.561	6.120	294.930	6.548	305.732
2.901	249.910	3.382	264.644	3.840	269.158	4.315	263.586	4.777	268.993	5.233	277.303	5.687	285.671	6.117	295.118	6.556	306.786
2.900	249.975	3.371	264.578	3.833	269.293	4.319	263.761	4.785	270.037	5.233	277.347	5.690	285.781	6.129	295.228	6.567	306.996
2.917	249.932	3.378	264.600	3.841	269.247	4.331	263.805	4.787	270.147	5.242	277.347	5.694	285.803	6.141	295.272	6.565	306.974
2.913	250.064	3.381	264.798	3.856	269.247	4.331	263.783	4.783	270.169	5.254	277.546	5.698	285.957	6.137	295.294	6.577	306.258
2.915	250.152	3.382	264.842	3.860	269.291	4.335	263.915	4.791	270.301	5.262	277.656	5.698	286.023	6.138	295.514	6.587	306.348
2.927	250.108	3.386	264.798	3.861	269.313	4.329	263.981	4.798	270.433	5.264	277.722	5.700	286.068	6.137	295.492	6.584	306.458
2.930	250.218	3.395	264.842	3.880	269.335	4.345	264.069	4.794	270.433	5.264	277.722	5.700	286.068	6.137	295.492	6.584	306.458
2.929	250.262	3.401	264.997	3.861	269.357	4.332	264.113	4.804	270.477	5.281	277.854	5.712	286.178	6.142	295.688	6.573	306.436
2.934	250.196	3.403	265.019	3.872	269.467	4.340	264.069	4.812	270.521	5.270	277.898	5.710	286.288	6.150	295.823	6.579	306.546

[Table 10]-1

		compression test table: (1) Strain (%) (2) Stress (MPa)											
(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
6.584	306.811	7.000	319.517	7.405	334.248	7.794	351.138	8.169	369.393	8.537	388.198	8.930	406.938
6.583	306.943	7.002	319.627	7.407	334.402	7.798	351.314	8.178	369.437	8.537	388.418	8.932	407.136
6.581	307.075	7.011	319.737	7.423	334.646	7.794	351.402	8.175	369.635	8.555	388.573	8.924	407.280
6.583	307.075	7.014	319.869	7.412	334.777	7.808	351.644	8.184	369.943	8.562	388.857	8.939	407.532
6.598	307.251	7.019	320.001	7.420	335.019	7.810	351.710	8.186	370.119	8.566	388.969	8.933	407.730
6.596	307.361	7.018	320.177	7.420	335.107	7.812	351.975	8.192	370.334	8.559	389.189	8.931	407.929
6.609	307.493	7.033	320.265	7.423	335.239	7.818	352.151	8.198	370.318	8.577	389.431	8.939	408.083
6.610	307.670	7.025	320.441	7.440	335.395	7.821	352.327	8.198	370.604	8.572	389.519	8.944	408.281
6.617	307.714	7.042	320.618	7.439	335.591	7.821	352.525	8.209	370.868	8.579	389.740	8.943	408.479
6.620	307.824	7.039	320.684	7.441	335.746	7.822	352.613	8.202	371.022	8.580	389.872	8.943	408.577
6.636	307.978	7.046	320.950	7.445	335.856	7.824	352.922	8.205	371.243	8.580	390.092	8.951	408.863
6.628	308.154	7.048	320.948	7.442	336.032	7.828	353.010	8.210	371.419	8.593	390.290	8.967	409.228
6.636	308.220	7.051	321.168	7.449	336.208	7.848	353.230	8.217	371.595	8.591	390.486	8.962	409.404
6.635	308.352	7.060	321.234	7.447	336.406	7.846	353.384	8.217	371.771	8.590	390.675	8.978	409.646
6.645	308.462	7.054	321.432	7.460	336.516	7.848	353.626	8.218	371.991	8.591	390.951	8.977	409.678
6.647	308.572	7.059	321.586	7.461	336.670	7.857	353.692	8.228	372.189	8.594	391.105	8.977	409.778
6.651	308.705	7.060	321.719	7.467	336.869	7.853	354.089	8.231	372.376	8.608	391.149	8.980	409.964
6.668	308.748	7.063	321.939	7.467	337.001	7.854	354.133	8.231	372.476	8.610	391.351	8.985	410.175
6.668	308.947	7.070	321.939	7.473	337.177	7.859	354.375	8.238	372.740	8.620	391.611	8.986	410.263
6.670	309.189	7.081	322.137	7.473	337.309	7.867	354.419	8.238	372.869	8.620	391.810	8.994	410.461
6.677	309.277	7.084	322.269	7.472	337.529	7.863	354.705	8.233	373.092	8.622	391.942	8.996	410.703
6.677	309.475	7.092	322.533	7.490	337.727	7.881	354.881	8.251	373.312	8.622	392.162	8.996	411.144
6.684	309.475	7.100	322.688	7.498	337.992	7.877	355.234	8.254	373.577	8.628	392.426	9.000	411.144
6.685	309.673	7.103	322.820	7.503	338.146	7.878	355.432	8.265	373.887	8.631	392.778	9.001	411.430
6.686	309.762	7.118	322.952	7.503	338.102	7.881	355.564	8.267	374.161	8.640	392.911	9.015	411.596
6.689	309.938	7.106	323.150	7.508	338.368	7.865	355.696	8.265	374.215	8.643	393.153	9.016	411.782
6.700	309.982	7.116	323.282	7.516	338.674	7.903	356.894	8.276	374.413	8.654	393.905	9.024	412.166
6.699	310.136	7.117	323.435	7.513	338.983	7.880	356.181	8.278	374.590	8.654	393.905	9.024	412.166
6.714	310.290	7.123	323.502	7.513	338.981	7.906	356.225	8.278	374.788	8.655	393.951	9.032	412.333
6.703	310.356	7.129	323.700	7.520	339.137	7.910	356.445	8.282	374.920	8.666	393.890	9.027	412.509
6.718	310.488	7.129	323.810	7.527	339.291	7.903	356.655	8.286	375.162	8.661	394.056	9.040	412.729
6.729	310.642	7.132	324.009	7.532	339.467	7.902	356.841	8.291	375.426	8.664	394.298	9.035	412.861
6.728	310.774	7.126	324.119	7.525	339.589	7.917	357.171	8.294	375.603	8.675	394.518	9.044	413.059
6.725	310.862	7.133	324.251	7.542	339.621	7.915	357.193	8.299	375.757	8.683	394.606	9.047	413.280
6.731	311.017	7.138	324.361	7.543	339.952	7.926	357.370	8.309	375.898	8.683	394.848	9.048	413.434
6.730	311.127	7.145	324.559	7.544	340.194	7.935	357.568	8.307	376.109	8.686	395.245	9.052	413.862
6.737	311.259	7.156	324.757	7.551	340.216	7.935	357.744	8.309	376.219	8.686	395.245	9.052	413.862
6.743	311.479	7.156	324.845	7.558	340.436	7.930	357.964	8.311	376.461	8.692	395.333	9.053	414.066
6.748	311.501	7.150	324.934	7.557	340.546	7.940	358.140	8.312	376.660	8.703	395.597	9.065	414.138
6.748	311.655	7.168	325.154	7.561	340.766	7.949	358.295	8.320	376.890	8.701	395.729	9.069	414.226
6.756	311.721	7.166	325.264	7.561	340.986	7.944	358.449	8.327	377.034	8.701	395.971	9.070	414.557
6.759	311.853	7.177	325.352	7.575	341.163	7.956	358.691	8.326	377.210	8.710	396.148	9.075	414.711
6.771	312.030	7.178	325.550	7.574	341.363	7.956	358.945	8.328	377.436	8.706	396.324	9.082	414.931
6.778	312.140	7.182	325.748	7.577	341.449	7.959	359.043	8.340	377.673	8.708	396.698	9.086	415.063
6.771	312.228	7.177	325.858	7.585	341.669	7.961	359.175	8.338	377.783	8.711	396.698	9.082	415.305
6.777	312.184	7.196	326.057	7.582	341.713	7.963	359.417	8.344	378.003	8.716	396.886	9.102	415.437
6.785	312.492	7.184	326.189	7.587	341.955	7.973	359.580	8.340	378.223	8.723	397.117	9.093	415.558
6.789	312.624	7.212	326.355	7.590	342.131	7.966	359.924	8.356	378.377	8.726	397.469	9.100	415.812
6.785	312.778	7.196	326.453	7.589	342.308	7.980	359.924	8.348	378.597	8.738	397.425	9.109	415.966
6.798	311.888	7.205	326.585	7.598	342.396	7.986	360.078	8.361	378.708	8.740	397.579	9.108	416.164
6.802	311.021	7.208	326.695	7.605	342.506	7.983	360.232	8.360	378.950	8.750	397.865	9.110	416.362

Table 101-2

6.903	313.043	7.216	326.893	7.610	342.770	7.984	360.320	8.354	379.126	8.745	398.063	9.112	416.539	9.491	434.485	9.870	451.749
6.905	313.175	7.223	327.026	7.613	342.980	7.998	360.717	8.369	379.302	8.757	398.173	9.122	416.593	9.497	434.539	9.874	451.771
6.913	313.417	7.224	327.202	7.616	343.144	7.998	360.927	8.369	379.544	8.741	398.417	9.115	416.547	9.500	434.705	9.869	451.959
6.921	313.505	7.225	327.312	7.616	343.277	7.995	361.047	8.366	379.676	8.755	398.558	9.132	417.067	9.501	434.925	9.869	452.124
6.920	313.615	7.225	327.488	7.627	343.497	7.995	361.223	8.369	379.875	8.765	398.812	9.129	417.267	9.508	435.146	9.869	452.168
6.920	313.747	7.227	327.620	7.623	343.563	8.010	361.399	8.397	380.095	8.765	398.966	9.143	417.287	9.507	435.256	9.887	452.476
6.932	313.945	7.241	327.818	7.625	343.739	8.005	361.532	8.393	380.271	8.770	399.164	9.136	417.551	9.515	435.542	9.891	452.652
6.918	313.835	7.249	327.994	7.633	343.959	8.010	361.774	8.395	380.425	8.779	399.319	9.136	417.794	9.517	435.564	9.898	452.762
6.938	313.988	7.251	328.104	7.643	344.320	8.019	361.928	8.398	380.513	8.787	399.451	9.150	418.014	9.517	435.806	9.896	452.960
6.944	314.430	7.254	328.171	7.647	344.334	8.027	362.104	8.400	380.843	8.767	399.671	9.143	418.168	9.528	436.005	9.904	453.291
6.937	314.562	7.256	328.589	7.658	344.696	8.029	362.345	8.406	381.020	8.770	399.935	9.165	418.388	9.536	436.335	9.928	453.467
6.948	314.628	7.263	328.919	7.665	345.170	8.040	362.905	8.423	381.745	8.793	400.618	9.169	418.697	9.545	436.555	9.935	453.621
6.948	314.826	7.273	329.183	7.667	345.501	8.044	363.261	8.426	382.385	8.807	401.232	9.180	419.586	9.557	437.568	9.952	454.634
6.965	315.068	7.273	329.250	7.677	345.501	8.059	363.469	8.432	382.627	8.807	401.587	9.185	419.974	9.567	437.706	9.953	454.810
6.876	315.201	7.278	329.470	7.675	345.831	8.050	363.623	8.438	382.737	8.807	401.741	9.196	420.150	9.567	437.854	9.946	454.964
6.881	315.365	7.279	329.624	7.675	345.831	8.059	363.968	8.438	382.737	8.807	401.741	9.196	420.150	9.567	437.854	9.946	454.964
6.876	315.443	7.278	329.624	7.675	345.831	8.050	363.623	8.438	382.737	8.807	401.741	9.196	420.150	9.567	437.854	9.946	454.964
6.876	315.697	7.297	329.734	7.677	346.183	8.070	364.130	8.436	383.913	8.824	401.961	9.192	420.348	9.573	438.097	9.968	455.118
6.890	315.773	7.298	329.910	7.677	346.183	8.070	364.130	8.436	383.913	8.824	401.961	9.192	420.348	9.573	438.097	9.968	455.118
6.899	315.795	7.299	330.064	7.685	346.382	8.074	364.570	8.453	383.966	8.825	402.137	9.184	420.480	9.578	438.405	9.967	455.449
6.896	315.927	7.304	330.240	7.689	346.536	8.074	364.570	8.453	383.966	8.825	402.137	9.184	420.480	9.578	438.405	9.967	455.449
6.893	316.081	7.302	330.263	7.699	346.908	8.085	364.702	8.455	383.966	8.834	402.556	9.202	420.700	9.578	438.647	9.965	455.449
6.904	316.257	7.311	330.483	7.691	346.954	8.080	364.879	8.462	383.966	8.834	402.556	9.202	420.700	9.578	438.647	9.965	455.449
6.911	316.412	7.311	330.681	7.700	347.054	8.089	365.077	8.466	384.014	8.853	402.896	9.215	421.801	9.602	438.528	9.982	456.660
6.911	316.412	7.324	330.857	7.707	347.282	8.083	365.165	8.469	384.014	8.853	402.896	9.215	421.801	9.602	438.528	9.982	456.660
6.917	316.675	7.320	330.901	7.721	347.394	8.094	365.473	8.466	384.433	8.845	403.304	9.221	421.801	9.602	438.528	9.982	456.660
6.917	316.742	7.325	331.121	7.731	347.526	8.097	365.627	8.466	384.433	8.845	403.304	9.221	421.801	9.602	438.528	9.982	456.660
6.918	316.874	7.323	331.275	7.731	347.613	8.105	365.715	8.468	384.631	8.851	403.458	9.239	422.352	9.612	440.012	10.002	456.945
6.923	317.006	7.335	331.518	7.729	347.957	8.103	365.950	8.477	385.765	8.852	403.679	9.239	422.352	9.612	440.012	10.002	456.945
6.930	317.160	7.327	331.562	7.724	348.121	8.110	366.178	8.489	385.905	8.869	403.855	9.239	422.352	9.612	440.012	10.002	456.945
6.937	317.270	7.328	331.760	7.734	348.276	8.117	366.334	8.493	385.937	8.877	404.207	9.245	422.682	9.624	440.431	10.002	457.342
6.936	317.469	7.332	331.892	7.730	348.451	8.116	366.590	8.502	386.380	8.880	404.405	9.245	422.682	9.624	440.431	10.002	457.342
6.937	317.623	7.345	331.936	7.739	348.628	8.122	366.750	8.504	386.556	8.875	404.625	9.254	422.682	9.624	440.431	10.002	457.342
6.945	317.733	7.347	332.244	7.748	348.716	8.124	366.882	8.504	386.556	8.875	404.625	9.254	422.682	9.624	440.431	10.002	457.342
6.948	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.024	8.121	367.103	8.503	386.574	8.881	404.758	9.257	423.145	9.624	440.431	10.002	457.342
6.949	317.798	7.359	332.549	7.752	349.												

[Table 1]-1

		compression test table: (1) Strain (%) (2) Stress (MPa)											
(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
10.065	459.589	10.454	475.685	10.848	491.078	11.259	505.523	11.673	518.978	12.090	531.485	12.511	542.848
10.063	459.787	10.490	476.560	10.854	491.188	11.264	505.577	11.677	519.154	12.094	531.639	12.521	543.002
10.066	459.007	10.457	476.038	10.867	491.329	11.273	505.787	11.684	519.264	12.101	531.683	12.532	543.134
10.071	460.139	10.475	476.170	10.879	491.496	11.276	505.966	11.691	519.418	12.098	531.816	12.533	543.244
10.079	460.263	10.471	476.368	10.869	491.650	11.273	505.946	11.694	519.462	12.103	531.992	12.527	543.200
10.061	460.425	10.471	476.522	10.879	491.804	11.281	506.362	11.696	519.638	12.118	532.050	12.535	543.420
10.060	460.624	10.477	476.698	10.874	491.959	11.282	506.382	11.708	519.792	12.113	532.190	12.545	543.508
10.068	460.800	10.488	476.830	10.874	492.091	11.285	506.514	11.705	519.903	12.119	532.256	12.549	543.685
10.068	460.998	10.485	477.007	10.870	492.311	11.294	506.546	11.717	520.079	12.127	532.410	12.545	543.761
10.101	461.108	10.498	477.095	10.885	492.443	11.293	506.900	11.719	520.123	12.128	532.454	12.560	543.861
10.069	461.240	10.492	477.315	10.892	492.575	11.294	506.910	11.725	520.239	12.130	532.674	12.560	543.883
10.100	461.416	10.502	477.513	10.904	492.707	11.307	507.020	11.732	520.475	12.135	532.740	12.563	544.015
10.108	461.614	10.508	477.667	10.907	492.861	11.309	507.307	11.728	520.519	12.148	532.895	12.575	544.191
10.122	461.791	10.508	477.733	10.906	493.060	11.307	507.175	11.723	520.607	12.128	533.049	12.562	544.301
10.120	461.945	10.516	477.821	10.905	493.170	11.327	507.439	11.741	520.827	12.148	533.115	12.577	544.543
10.125	462.077	10.512	478.130	10.906	493.104	11.325	507.515	11.732	520.915	12.150	533.247	12.569	544.499
10.130	462.253	10.522	478.306	10.916	493.455	11.327	507.789	11.742	521.047	12.160	533.379	12.573	544.830
10.131	462.363	10.530	478.416	10.920	493.566	11.331	507.989	11.755	521.180	12.167	533.379	12.589	544.830
10.139	462.505	10.532	478.592	10.926	493.698	11.333	508.055	11.755	521.366	12.169	533.665	12.593	544.862
10.143	462.737	10.530	478.746	10.928	493.852	11.341	508.166	11.767	521.444	12.164	533.709	12.593	544.940
10.137	462.914	10.533	479.032	10.944	493.984	11.341	508.276	11.762	521.576	12.171	533.841	12.610	546.028
10.149	463.090	10.543	479.032	10.940	494.117	11.351	508.046	11.772	521.708	12.178	533.753	12.602	546.028
10.151	463.256	10.549	479.253	10.942	494.227	11.355	508.518	11.766	521.950	12.188	534.084	12.608	546.314
10.147	463.376	10.544	479.319	10.948	494.513	11.361	508.572	11.766	521.954	12.189	534.238	12.611	546.336
10.162	463.540	10.568	479.495	10.953	494.523	11.365	508.892	11.777	522.017	12.191	534.248	12.628	546.446
10.159	463.728	10.565	479.649	10.956	494.865	11.357	508.980	11.783	522.281	12.180	534.458	12.619	546.534
10.167	463.850	10.564	479.803	10.964	494.969	11.374	509.046	11.778	522.469	12.193	534.690	12.628	546.666
10.180	463.949	10.571	480.045	10.965	495.063	11.383	509.201	11.789	522.479	12.205	534.634	12.642	546.754
10.171	464.235	10.565	480.156	10.970	495.218	11.378	509.465	11.788	522.611	12.217	534.700	12.640	546.821
10.181	464.389	10.575	480.266	10.975	495.305	11.374	509.509	11.788	522.743	12.213	534.898	12.645	546.931
10.182	464.587	10.577	480.486	10.971	495.504	11.393	509.541	11.802	522.853	12.224	534.964	12.643	546.041
10.190	464.697	10.585	480.552	10.971	495.636	11.382	509.817	11.811	522.985	12.214	534.964	12.648	546.195
10.191	464.851	10.589	480.729	10.984	495.790	11.398	509.949	11.809	523.065	12.233	535.163	12.656	546.371
10.199	465.094	10.597	480.948	10.985	495.922	11.400	509.971	11.819	523.206	12.231	535.339	12.657	546.437
10.188	465.182	10.579	481.080	10.995	496.098	11.403	510.100	11.814	523.382	12.233	535.427	12.659	546.525
10.211	465.270	10.593	481.213	10.996	496.253	11.405	510.390	11.811	523.470	12.233	535.427	12.668	546.459
10.216	465.534	10.599	481.345	11.005	496.363	11.412	510.506	11.834	523.690	12.240	535.713	12.676	546.979
10.202	465.754	10.601	481.521	10.996	496.539	11.416	510.588	11.834	523.734	12.248	535.901	12.673	546.965
10.222	465.842	10.606	481.653	11.011	496.715	11.418	510.786	11.831	523.932	12.256	535.911	12.672	546.965
10.216	466.019	10.606	481.807	11.020	496.693	11.415	510.918	11.835	524.020	12.262	535.867	12.678	547.032
10.231	466.129	10.607	481.983	11.012	496.869	11.430	511.050	11.837	524.130	12.264	536.154	12.688	547.164
10.231	466.327	10.615	482.155	11.015	497.133	11.434	511.135	11.847	524.241	12.263	536.242	12.695	547.274
10.225	466.151	10.628	482.245	11.021	497.221	11.434	511.336	11.840	524.395	12.273	536.352	12.693	547.262
10.234	466.535	10.637	482.314	11.025	497.288	11.440	511.469	11.857	524.461	12.269	536.506	12.697	547.362
10.237	466.789	10.632	482.622	11.032	497.552	11.437	511.667	11.862	524.615	12.281	536.616	12.701	547.500
10.245	466.833	10.644	482.710	11.033	497.705	11.445	511.733	11.861	524.747	12.288	536.704	12.710	547.670
10.239	467.208	10.642	482.885	11.043	497.882	11.449	511.843	11.870	524.879	12.287	536.814	12.715	547.736
10.268	467.340	10.642	482.974	11.050	497.948	11.459	511.975	11.871	525.033	12.282	536.924	12.722	547.890
10.251	467.450	10.655	483.219	11.045	498.146	11.455	511.975	11.877	525.011	12.285	537.034	12.731	547.957
10.260	467.604	10.661	483.349	11.054	498.300	11.462	512.249	11.884	525.077	12.293	537.075	12.736	548.111
10.265	467.846	10.655	483.415	11.044	498.410	11.464	512.416	11.888	525.341	12.294	537.180	12.724	548.243
10.268	467.996	10.665	483.679	11.055	498.499	11.469	512.548	11.885	525.462	12.297	537.453	12.730	548.287

[Table 1]-2

10.265	467.956	10.665	483.855	11.060	498.697	11.473	512.812	11.893	525.584	12.310	537.541	12.738	548.419	13.181	558.132
10.277	468.243	10.666	483.987	11.072	498.829	11.473	512.856	11.901	525.738	12.318	537.563	12.742	548.485	13.191	558.240
10.276	468.463	10.677	484.031	11.073	499.071	11.473	512.856	11.901	525.738	12.315	537.563	12.741	548.617	13.187	558.306
10.283	468.639	10.679	484.296	11.080	499.071	11.486	513.010	11.900	525.980	12.317	537.915	12.758	548.749	13.185	558.438
10.288	468.925	10.679	484.361	11.088	499.247	11.494	513.208	11.906	526.244	12.330	538.025	12.753	548.837	13.197	558.548
10.289	468.925	10.687	484.582	11.098	499.423	11.500	513.208	11.913	526.090	12.334	538.091	12.755	548.837	13.189	558.659
10.287	469.123	10.694	484.736	11.095	499.578	11.501	513.340	11.913	526.443	12.332	538.290	12.778	548.970	13.207	558.681
10.295	469.233	10.693	484.868	11.105	499.754	11.514	513.605	11.919	526.443	12.341	538.334	12.776	549.124	13.208	558.769
10.294	469.398	10.705	485.000	11.102	499.842	11.502	513.759	11.922	526.597	12.340	538.466	12.777	549.234	13.214	558.857
10.368	469.542	10.659	485.176	11.096	499.974	11.515	513.891	11.925	526.751	12.332	538.576	12.776	549.322	13.223	558.945
10.365	469.740	10.711	485.308	11.112	500.084	11.510	513.979	11.932	526.839	12.344	538.762	12.790	549.454	13.213	559.055
10.316	469.894	10.711	485.485	11.109	500.290	11.515	514.111	11.931	526.971	12.354	538.708	12.797	549.564	13.228	559.143
10.320	469.962	10.724	485.617	11.110	500.436	11.524	514.287	11.937	527.103	12.360	538.928	12.797	549.608	13.239	559.209
10.318	470.180	10.725	485.793	11.124	500.525	11.526	514.441	11.943	527.257	12.363	539.038	12.801	549.762	13.239	559.319
10.326	470.335	10.725	486.013	11.127	500.701	11.537	514.530	11.944	527.345	12.359	539.126	12.801	549.906	13.240	559.386
10.324	470.511	10.727	486.101	11.121	500.877	11.539	514.662	11.949	527.455	12.371	539.192	12.807	549.960	13.239	559.495
10.321	470.731	10.724	486.290	11.135	500.987	11.548	514.926	11.949	527.742	12.382	539.170	12.802	550.027	13.244	559.627
10.337	470.907	10.731	486.431	11.141	501.185	11.544	514.970	11.959	527.852	12.390	539.589	12.812	550.291	13.252	559.803
10.335	470.995	10.734	486.608	11.139	501.295	11.546	515.080	11.969	527.874	12.390	539.689	12.813	550.401	13.257	559.848
10.345	471.083	10.739	486.696	11.152	501.471	11.547	515.212	11.960	528.094	12.393	539.831	12.838	550.655	13.272	559.958
10.343	471.281	10.729	486.718	11.151	501.626	11.557	515.322	11.974	528.094	12.396	539.919	12.827	550.379	13.273	560.024
10.351	471.435	10.745	487.004	11.150	501.714	11.557	515.432	11.971	528.138	12.396	539.919	12.828	550.665	13.282	560.134
10.357	471.744	10.754	487.202	11.162	501.868	11.566	515.609	11.985	528.248	12.404	540.007	12.833	550.708	13.276	560.244
10.357	471.744	10.749	487.312	11.160	502.000	11.561	515.719	11.988	528.424	12.408	540.139	12.845	550.907	13.287	560.266
10.365	471.964	10.763	487.488	11.164	502.132	11.576	515.851	11.984	528.557	12.407	540.315	12.846	550.929	13.287	560.376
10.369	472.096	10.759	487.599	11.165	502.254	11.576	516.006	11.996	528.645	12.415	540.381	12.846	550.929	13.287	560.376
10.376	472.228	10.765	487.763	11.170	502.440	11.580	516.159	12.000	528.799	12.419	540.492	12.861	551.127	13.297	560.496
10.372	472.448	10.772	487.885	11.175	502.550	11.582	516.247	11.998	528.909	12.427	540.580	12.851	551.105	13.305	560.552
10.376	472.537	10.782	488.017	11.176	502.727	11.583	516.401	12.005	529.085	12.426	540.690	12.866	551.216	13.293	560.682
10.387	472.669	10.776	488.269	11.177	502.861	11.582	516.467	12.002	529.217	12.427	540.800	12.860	551.348	13.313	560.728
10.381	472.845	10.784	488.369	11.190	502.925	11.609	516.687	12.015	529.327	12.441	540.954	12.879	551.436	13.317	560.816
10.388	473.087	10.789	488.523	11.192	503.057	11.604	516.788	12.017	529.459	12.442	541.042	12.863	551.546	13.336	560.995
10.387	473.219	10.786	488.678	11.195	503.343	11.600	517.084	12.020	529.547	12.441	541.162	12.876	551.634	13.316	560.971
10.397	473.351	10.794	488.832	11.202	503.453	11.609	517.062	12.022	529.702	12.455	541.240	12.874	551.788	13.329	561.081
10.395	473.463	10.799	488.810	11.207	503.475	11.620	517.194	12.025	529.812	12.453	541.262	12.881	551.832	13.321	561.191
10.401	473.682	10.807	489.118	11.212	503.739	11.611	517.216	12.037	529.922	12.455	541.483	12.899	551.854	13.337	561.301
10.399	473.814	10.823	489.272	11.207	503.850	11.628	517.458	12.038	530.032	12.460	541.583	12.896	552.206	13.343	561.367
10.410	474.034	10.819	489.382	11.220	504.048	11.639	517.590	12.033	530.164	12.461	541.703	12.897	552.096	13.344	561.455
10.408	474.254	10.822	489.536	11.219	504.180	11.630	517.701	12.047	530.274	12.476	541.813	12.899	552.273	13.346	561.521
10.421	474.364	10.816	489.768	11.222	504.246	11.631	517.811	12.052	530.406	12.471	541.923	12.912	552.316	13.354	561.631
10.426	474.474	10.831	489.801	11.232	504.400	11.641	517.948	12.050	530.560	12.472	542.033	12.912	552.449	13.361	561.697
10.428	474.651	10.825	489.933	11.233	504.532	11.643	518.097	12.050	530.671	12.490	542.098	12.923	552.537	13.366	561.763
10.434	474.805	10.833	490.176	11.241	504.708	11.656	518.229	12.056	530.781	12.495	542.209	12.927	552.647	13.377	561.873
10.437	474.981	10.842	490.329	11.247	504.841	11.646	518.329	12.074	530.957	12.498	542.363	12.921	552.795	13.377	561.851
10.441	475.113	10.837	490.439	11.249	504.965	11.658	518.515	12.074	531.001	12.499	542.473	12.943	552.845	13.371	562.028
10.445	475.245	10.840	490.615	11.253	505.105	11.665	518.647	12.078	531.155	12.503	542.540	12.943	552.911	13.380	562.028
10.447	475.399	10.844	490.747	11.255	505.149	11.666	518.691	12.081	531.243	12.504	542.672	12.941	553.065	13.385	562.028
10.451	475.487	10.847	490.946	11.250	505.391	11.670	518.890	12.081	531.375	12.507	542.760	12.949	553.175	13.388	562.270

[0069] Table 12 summarizes results obtained in a tensile test and a compression test regarding an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca alloy and an Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca-0.17 % Zr alloy as extruded at 300 °C and 350 °C, respectively.

[Table 12]

Tensile test at room temperature [(Proof stress ratio) = (Compression proof stress)/(Tensile proof stress) × 100 (%)]						
Alloy name	Extrusion temperature (°C)	Tensile proof stress (MPa)	Ultimate tensile strength (MPa)	Elongation to failure (%)	Compression proof stress (MPa)	Proof stress ratio (%)
Mg-2.3Zn-0.1Ag-0.1Ca	300	155	281	25.4	141	91
	350	135	277	24.3	103	76
Mg-2.3Zn-0.1Ag-0.1Ca-0.17 Zr	300	306	364	17	271	89
	350	288	351	17.1	246	85

[0070] It is noted from these results that the hot extruded Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca alloy and Mg-2.3 % Zn-0.1 % Ag-0.1 % Ca,-0.17 % Zr alloy are a material having both high strength and high ductility and having small anisotropy in proof stress.

[0071] It is considered that revealment of such excellent mechanical properties with small anisotropy in strength as well as high strength and high ductility has a relationship with a fine grain, a lowering in a degree of the basal texture and a fine precipitate within the grain.

INDUSTRIAL APPLICABILITY

[0072] The material of this invention has high strength and high ductility and can be used for transportation equipment which is expected to realize weight reduction as a replacement for Al alloys, such as automobiles, motorcycles, aircrafts, etc. Furthermore, since the mechanical properties of the material of this Invention can be obtained without necessity of an additional heat treatment after the hot working, the material of this invention is also expected as a replacement for currently used wrought Mg alloys. Also, in view of the fact that the samples after hot extrusion at 350°C display an ultrafine grain structure of about 500 nm in terms of an average grain size, there is a possibility that the material of this Invention is applicable as a superplastic material.

Claims

1. An Mg base alloy containing Mg as a main material and Zn as an additive material, which is **characterized in that** Ag is contained in an amount of not more than 1.98 at% as an additive material other than Zn.
2. The Mg base alloy according to claim 1, which is **characterized in that** Ca is further contained in an amount of not more than 0.61 at% as an additive material other than Zn and Ag.
3. The Mg base alloy according to claim 2, which is **characterized in that** Zr is further contained in an amount of not more than 0.17 at% as an additive material other than Zn, Ag and Ca.
4. The Mg base alloy according to any one of claims 1 to 3, which is **characterized in that** a grain size thereof is from 0.1 μm to 25 μm .

Fig. 1

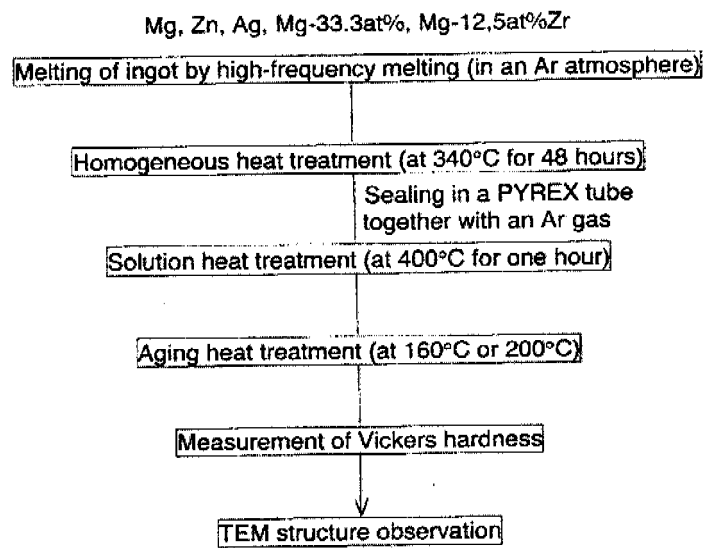


Fig. 2

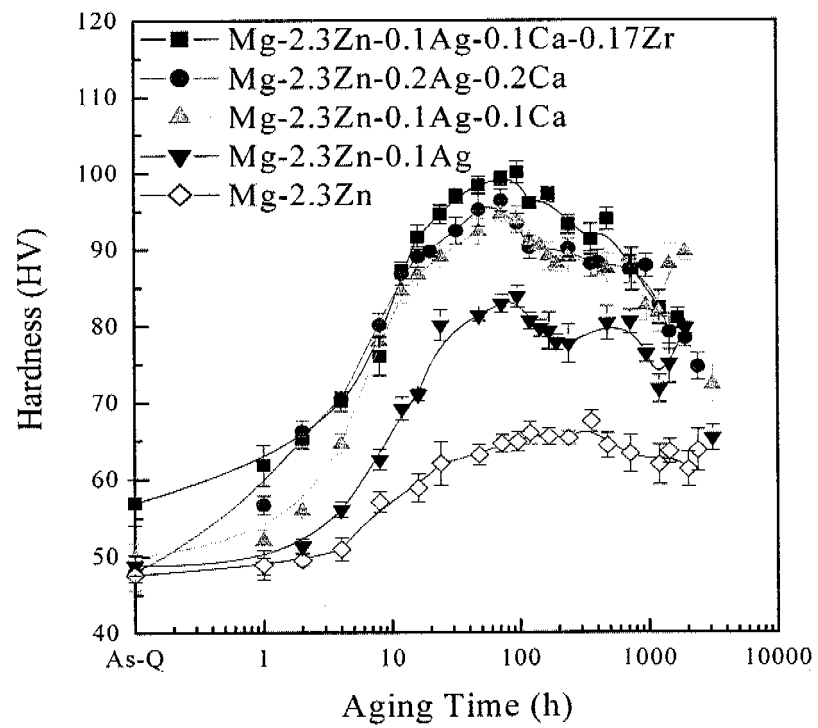


Fig. 3

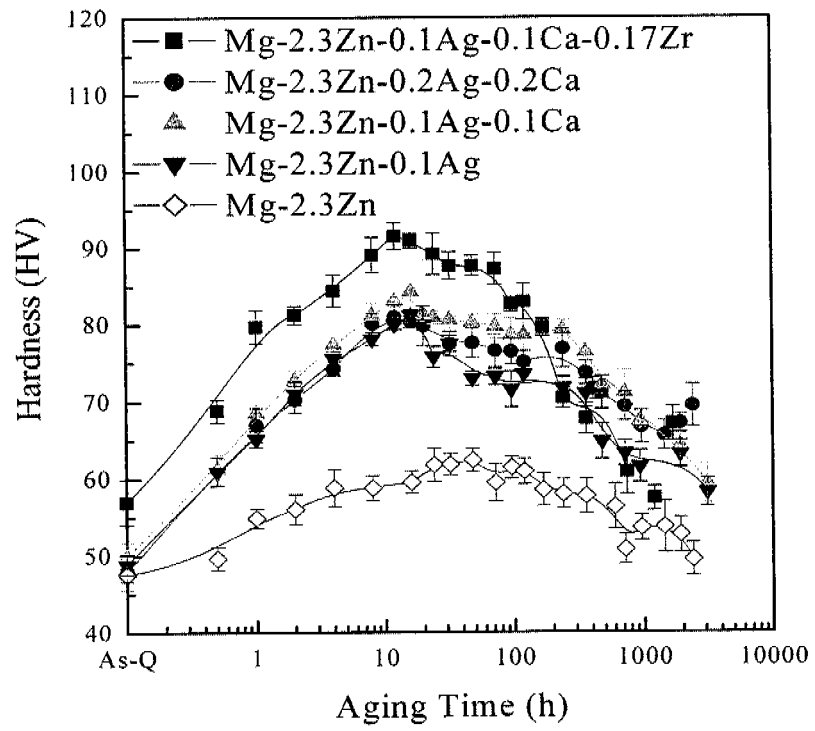


Fig. 4

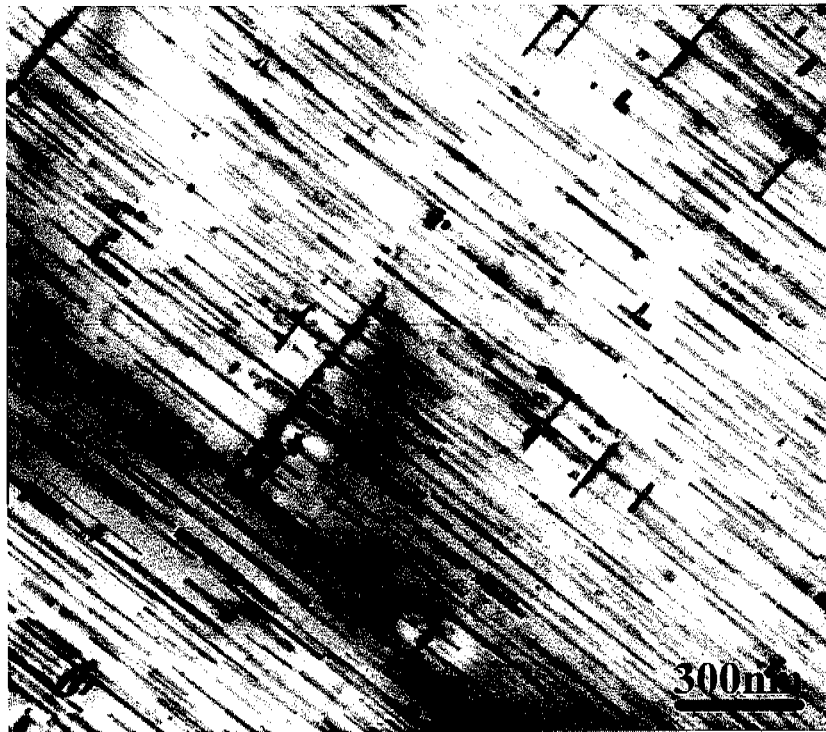


Fig. 5

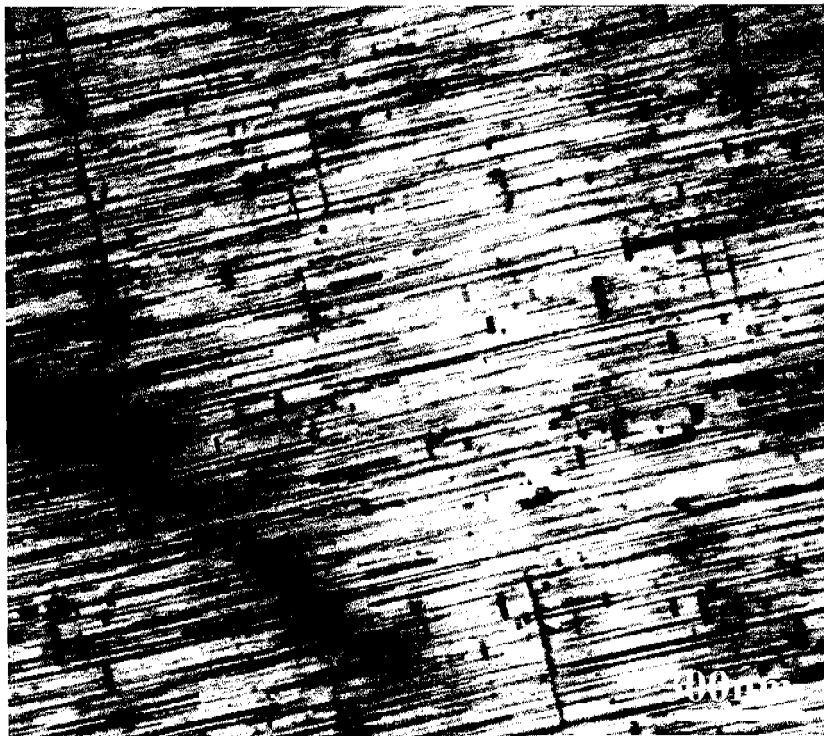


Fig. 6

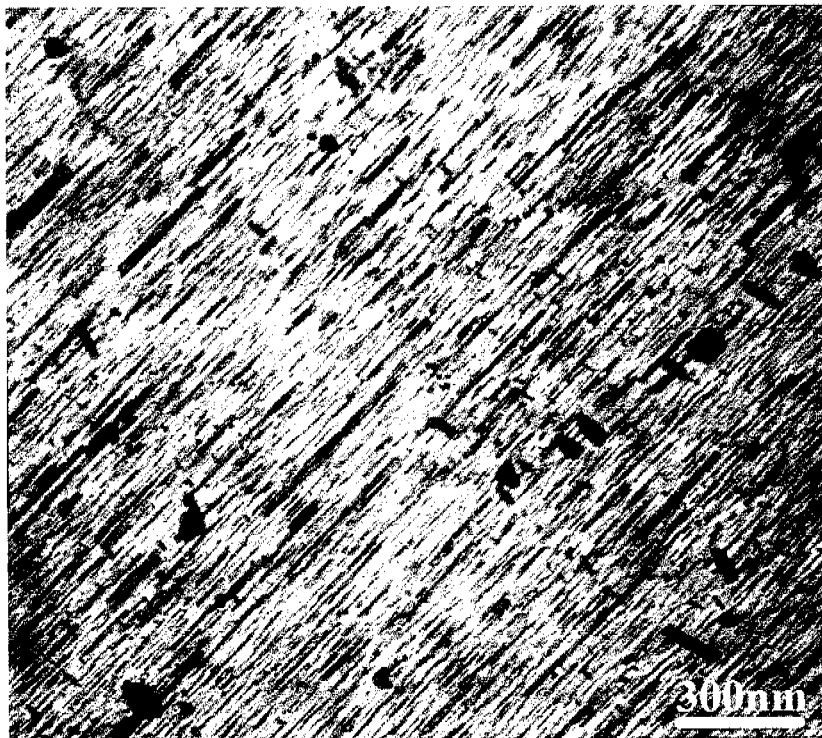


Fig. 7



Fig. 8

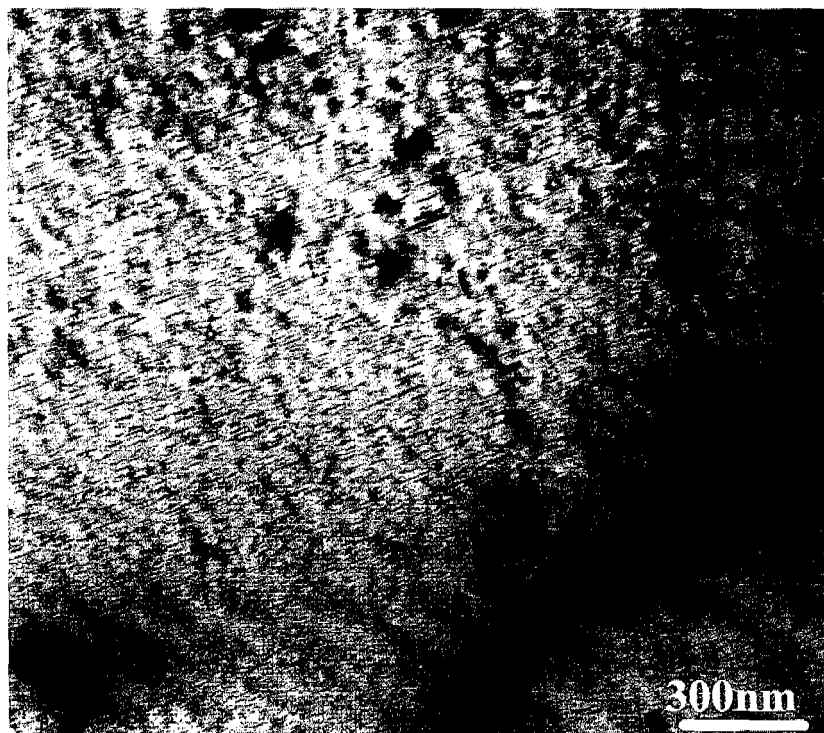


Fig. 9

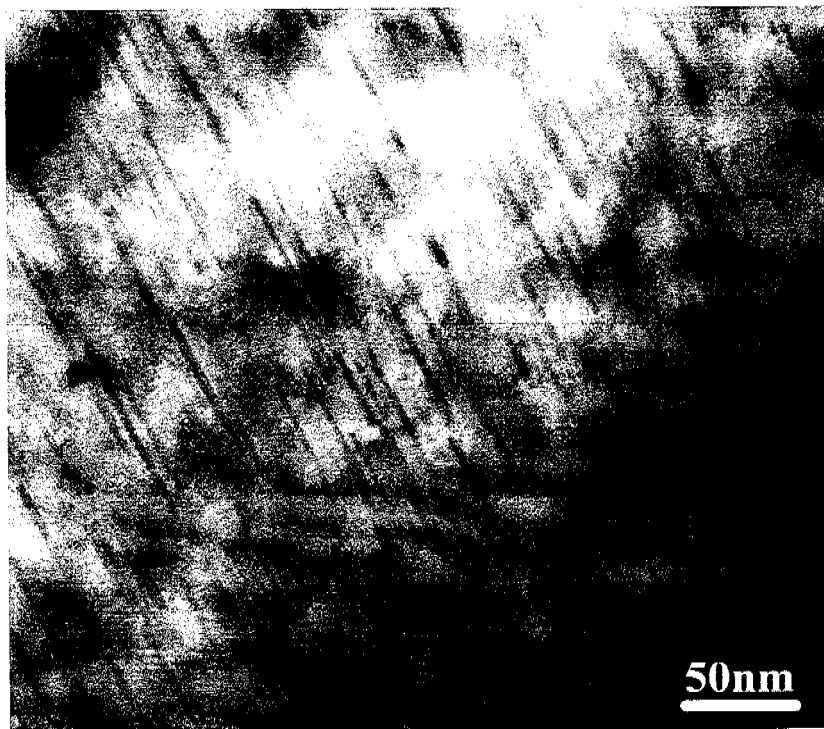


Fig. 10

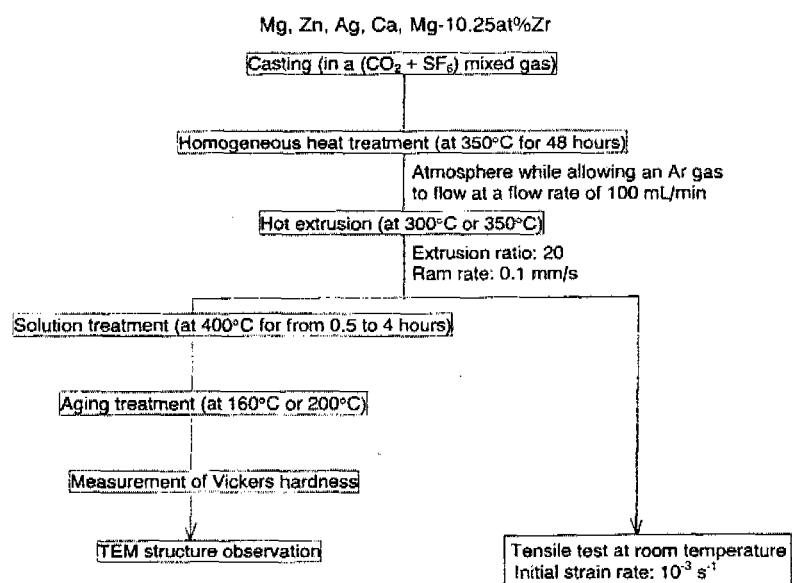


Fig. 11

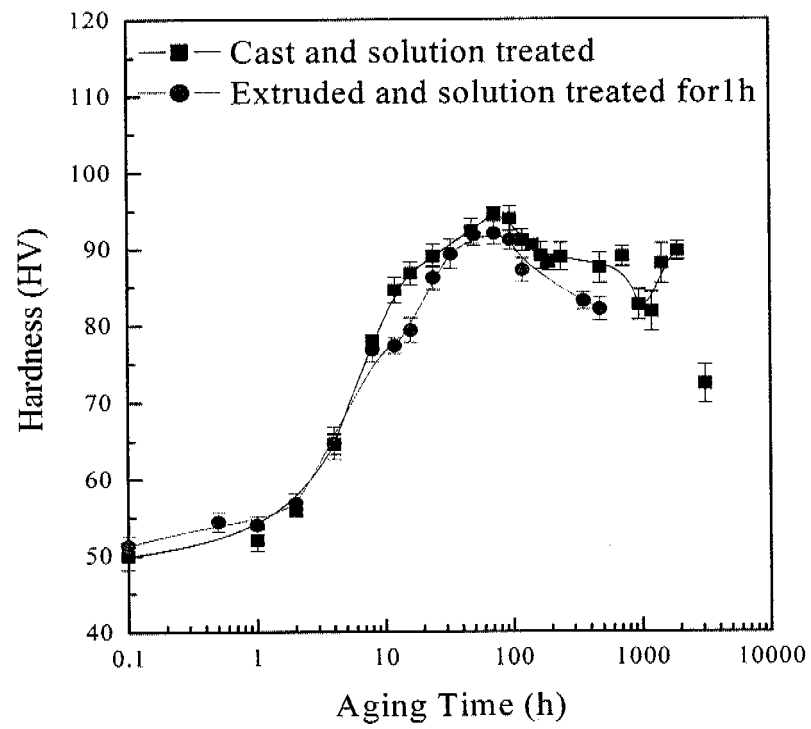


Fig. 12

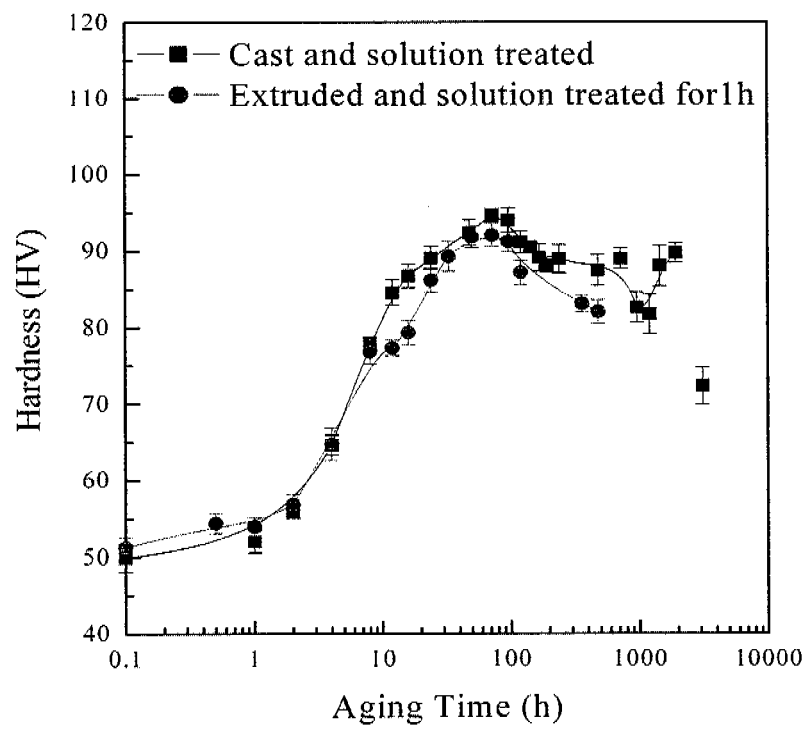


Fig. 13

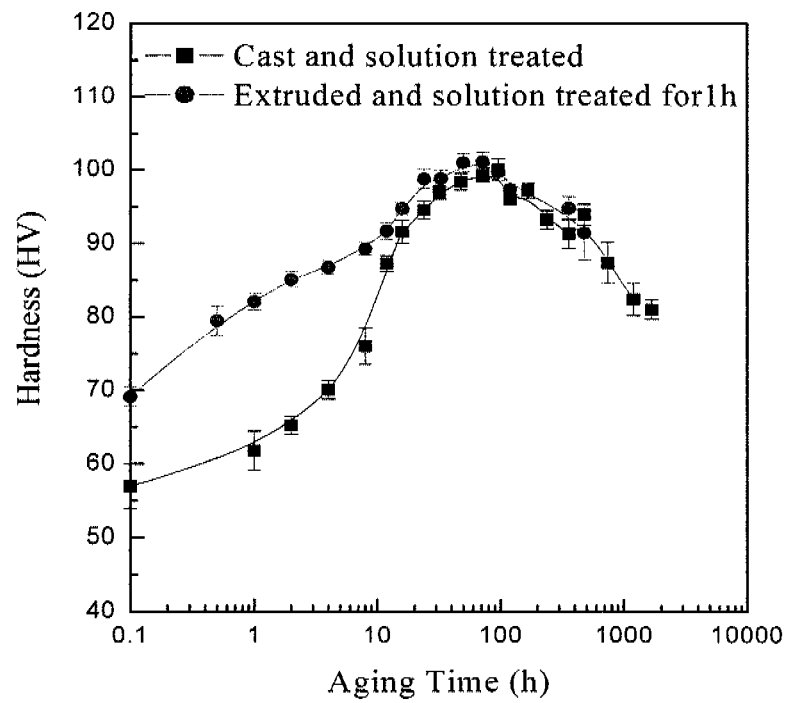


Fig. 14

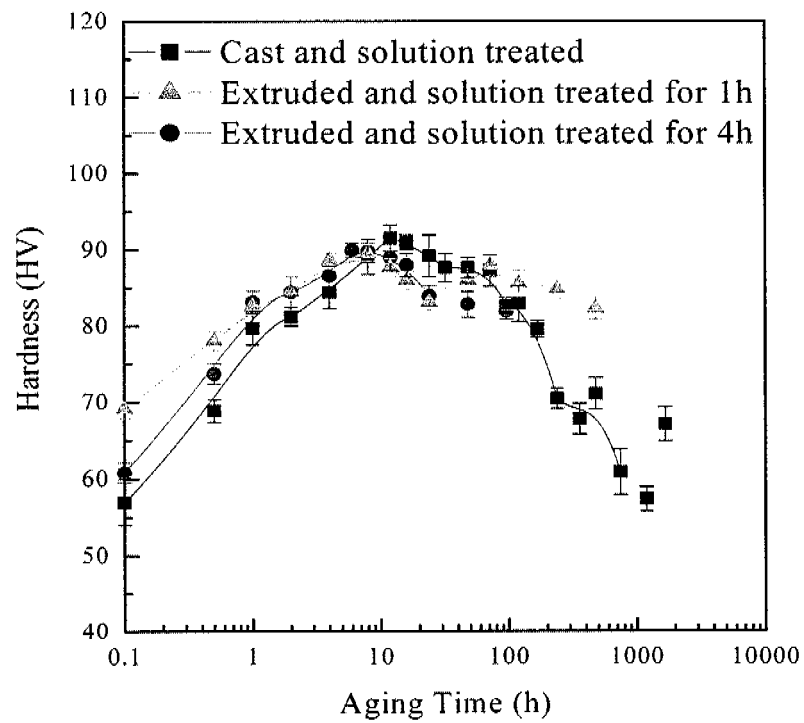


Fig. 15

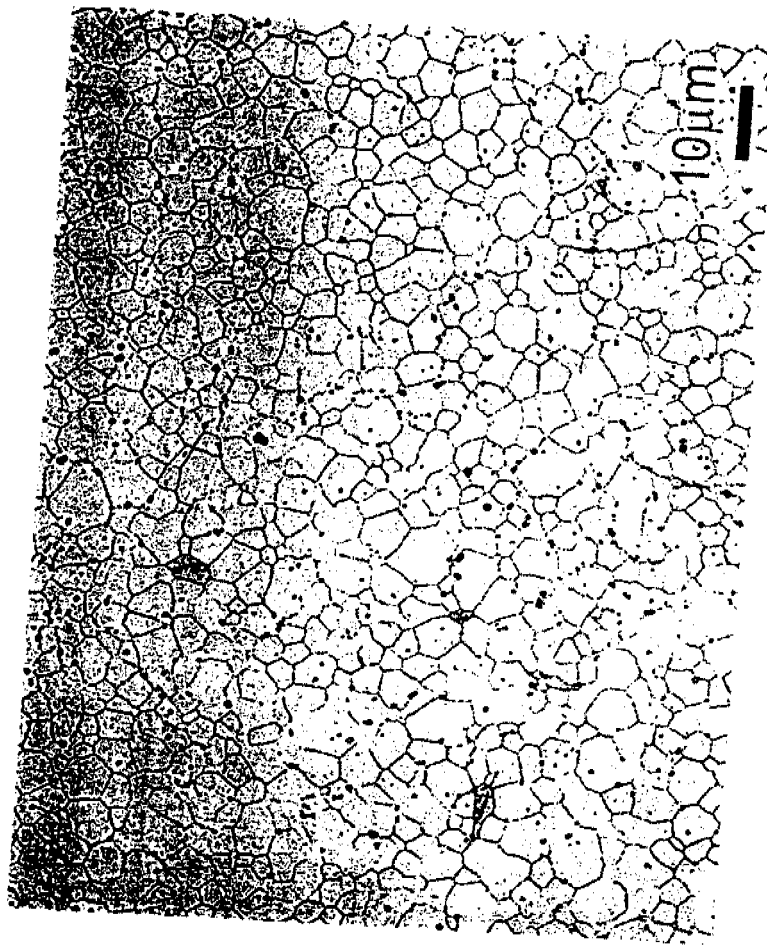


Fig. 16



Fig. 17



Fig. 18

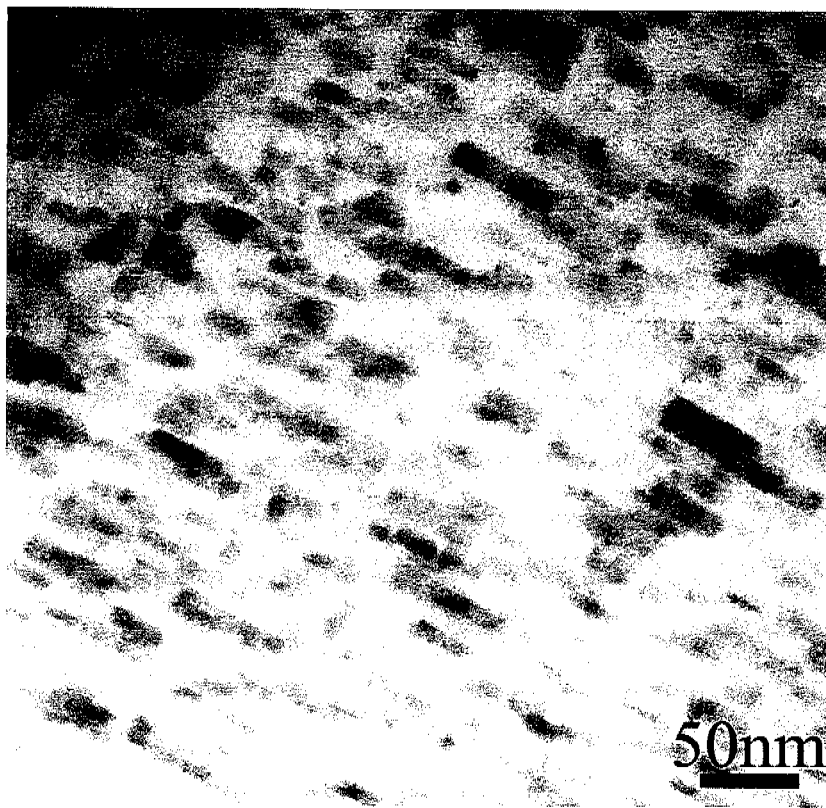


Fig. 19

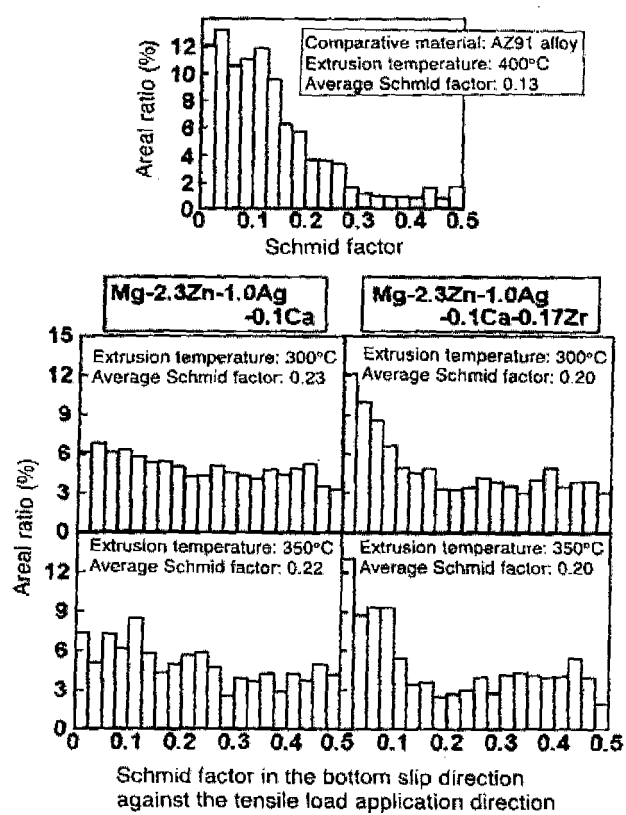
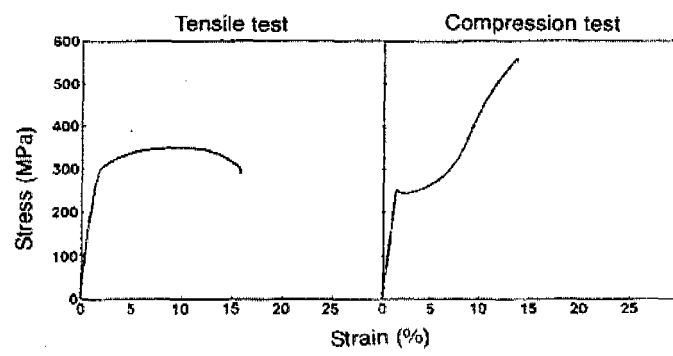


Fig. 20



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/058677

A. CLASSIFICATION OF SUBJECT MATTER

C22C23/04 (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)

C22C23/00-23/06

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008

Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2001-300643 A (Mitsui Mining & Smelting Co., Ltd.), 30 October, 2001 (30.10.01), Claims (Family: none)	1-4
X	JP 2001-239326 A (Mitsui Mining & Smelting Co., Ltd.), 04 September, 2001 (04.09.01), Claims & CN 1311066 A	1-4
X	JP 2003-328063 A (Toyo Kohan Co., Ltd.), 19 November, 2003 (19.11.03), Claims; Par. Nos. [0015], [0017] & WO 2003/095691 A1	1-4

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

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Date of the actual completion of the international search

18 July, 2008 (18.07.08)

Date of mailing of the international search report

05 August, 2008 (05.08.08)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/058677

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2003-328064 A (Toyo Kohan Co., Ltd.), 19 November, 2003 (19.11.03), Claims; Par. Nos. [0015], [0017] (Family: none)	1-4
X	WO 2005/052203 A1 (Yoshihito KAWAMURA), 09 June, 2005 (09.06.05), Claims & US 2007/0125464 A1 & EP 1688509 A1	1-4
X A	WO 2004/085689 A1 (Yoshihito KAWAMURA), 07 October, 2004 (07.10.04), Claims (Family: none)	1-3 4

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2003226929 A [0012]
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- JP 6025791 A [0012]