ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 1, January 2017

Annealing Process's Effects on Microstructure and Properties

Manoj Kumar

Department of Mechanical Engineering, Galgotias University, Yamuna Expressway Greater Noida, Uttar Pradesh, India

Email Id: manojkumar@Galgotiasuniversity.edu.in

ABSTRACT: The effect of temperature and time for annealing of AZ31B Mg alloy sheets ' microstructure and mechanical features was investigated. The specimens were deformed by general roll casting and combining electromagnetic field and ultrasonic energy field casting. The study of the microstructure showed that the re-crypt age temperature of the combined Mg plate energy field is lower than the average Mg layer. At 250 ° C, no apparent recristalling for the general Mg strip sheet took place while the local recristalling of the Mg strip sheet occurred with the combination of rolling-casting in the energy field. The specimens of roll-casting Mg strips were, however, totally re-crystallized at a receipt time of 4h with fine grains and a regular microstructure in their specimens of the compound energy-field Mg strip, and had an average grain diameter of 14~19µm, 8~13µm respectively for the general Mg strip plate, with the combination of energy-field Mg strip panel. When the specimens were ground in 400 ° C, the grains became cough within 1 hour, the average diameters of grains for general Mg roll-casting sheet were 20~25 µm and 28~33 µm, respectively, and the combined Mg roll-casting sheet for energy fields were ground to 400 ° C for 1 hour. The tests of EDS revealed a decrease in the precipitate quantity of mg roller casting sheets by rinsing and the precipitates of the general mg roller casting plate with a thicker scale on the grain borders were enriched. Mechanical property results showed that the plastic deformation of casting blades Mg was improved markedly; HBS levels, Úb, Ţ0,2 and¨ of the mixture of Mg bandage were increased by 4.7%, 17.2%, 34.1%, 74.6%, compared with Mg sheet general, by 300oC / 4h.

KEYWORDS*:* annealing, combining energy-field, roll-casting, Mg alloy.

I.INTRODUCTION

Based on the importance of energy dialog and environmental protection for sustainable human development, Mg alloy is given unprecedented attention with lightweight and high strength characters, which are easy to process and recycle, etc. Mg alloy products are currently obtained mainly through casting or Multi-Pass rolling which, because of low yields, high energy consumption and poor plastic deformation, etc. limit the development and use of Mg alloy. Experts from home and abroad carried out a series of similar research in order to improve the performance of Mg alloy. The usefulness of grain grinding for the mechanical properties of Mg alloy. Roll-casting of electromagnetic fields was perfect for grain processing. The likelihood of fine and more uniform grains for roll-casting Mg alloy that was developed by ultrasonic field[1]–[3]. The Mg alloy roll-cast, which comes from the electromagnetic field and the ultrasonic field, will therefore have finer, flat grain except to minimize segregation. This is referred to below, as a mixture of energy fields.

Rolling-casting Mg sheets however, still have some problems, such as an uneven micro-structure, severe anisotropy and hardness, which have a major influence on Mg alloy subsequent processing. This means that further manufacturing properties of Mg alloy, the hot topic at home and abroad, are being strengthened. A reasonable amount of fine equated grains could be produced by the annealing temperature and keeping time, and finally, the deformation of Mg alloy was improved. The use of rinse to minimize residual stress, initial micro deformation and work hardening and eventually increase the Mg alloy subsequent processing efficiency. Heat treatment related general roll-casting articles are quite

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 1, January 2017

popular, but adding energy field roll-casting articles related to the heat treatment have not been documented so far[4], [5]. Therefore the thermal treatment experiments are of great importance for the application of alloy subsequent processing for the properties of mixing energy-field roll-casting AZ31B Mg alloy.

II.EXPERIMENT

Preparation of experimental materials:

Next, we will fill mixture in a certain proportion with pure industrial mg, pure aluminum and pure zinc, and then the mixture has been smelled [695~705 ° C temperature] in [200 kg capacity] resistance oven and deposited for half an hour. Ar was transferred to the resistance oven when melting, to prevent Mg melting from being oxidized and burned. Then the molten Mg passed through the groove, head box at 670~680 ° C, through the bridge, nozzle, etc. Finally, molten Mg was flown to the horizontal twin-roll casting machine with an area of approximately 400 mm to 500 mm and general roll-casting experiments were conducted and the combined power field-field roll-casting Mg alloy was combined with two types of AZ31B Mg roll-casting alloys which had a bright, neat 200 mm wide surface and a thickness of 4.8 mm [6], [7]. Table 1 showed AZ31B Mg chemical alloy composition:

Table 1: Chemical Composition of AZ31B Mg alloy [wt%]

Al	Zn	Cu≤	Mn≤	Cl ≤	Fe≤	Si≤	Mg
3.0~ 3.1	0.9~ 1.0	0.00 2	0.00 3	0.0 03	0.0 04	0.0 05	Bal.`

Experimental methods:

The KSW-4D-C EAF temperature controller, which is shown in Table 2, includes 2 kinds of roll-casting plate AZ31B Mg. The metallographic specimens were taken from annealed Mg sheets along the section, longitudinal section, and the normal section. After mosaic, water milling, rough grinding, thin grinding and polishing, corrosion and etc. were compared to and compared to Leica DMI 5000 M metallographic microscope. Tensile specimens of annealed Mg sheets were select ally intercepted along the lateral, vertical and 45o direction in compliance with GB / T 228-2002, Metallic Materials Process of Testing Tensile Method for three specimens is taken in all directions. The HW-187.5 Brinnell toughness test system and the ringing temperature were tested in the meantime and the reliability was measured in keeping with the alloy hardness law[8], [9]. Finally, the roll-casting Mg sheet precipitates were analyzed and compared further.

Table 2: Annealing Processes of Roll-Casting Mg Sheets

Process	NO.	Temp./℃	Time /h	Process	NO.	Temp./℃	Time/h
combiningene rgy-field	1#	250	1,2,3,4	general	4#	250	1,2,3,4
	2#	300	1,2,3,4		5#	300	1,2,3,4
	3#	400	1,2,3,4		6#	400	1,2,3,4

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

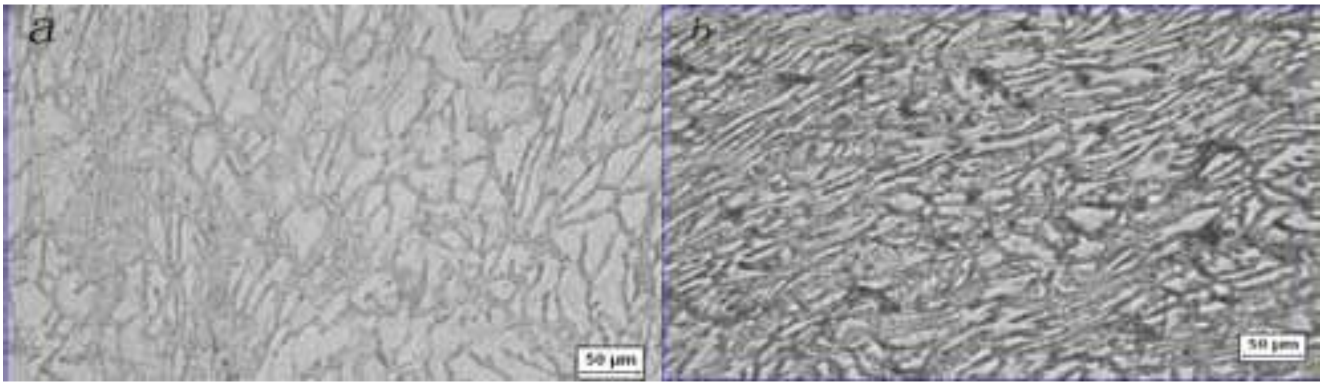
Website: www.ijareeie.com

Vol. 6, Issue 1, January 2017

III.RESULTS AND DISCUSSIONS

The microstructure of roll-casting Mg sheets:

Fig. 1: The microstructure of roll-casting Mg sheets a. general Mg sheet b. combining energy-field Mg sheet



The microstructure of roll-casting Mg sheets is shown in Fig. 1. Fig. 1a revealed that the chrysanthemum-like cellular dendrites of general Mg layer were coarse, the grain composition was heterogeneous, and the section of the grain diameters were greater than 200μm. Fig. 1b revealed that most chrysanthemums cellular Mg sheet dendrites were broken into granular, fibrous or massive and their average diameter of grains were approximately 30~40μm. We can conclude that the primary α-phases dendrite arms were cut and flowed into the liquid phase by means of oscillation and stirring of the combination of energy field, which increased collision and friction between liquid phase and nucleus [8]–[11]. The combined roll-casting of energy fields then played the role of standardized grains on the roll-casting Mg pads.

Annealing on the microstructure:

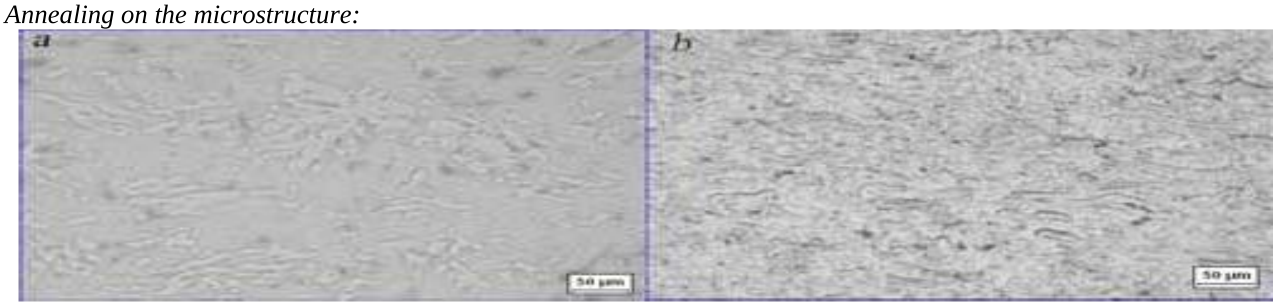


Fig. 2: The microstructure of Mg sheets at the annealing of 250℃×4h a. general Mg sheet b. combining energy-field Mg sheet

A large number of inter metallic blackened stick compounds, enriched within cellular dendrites of roll casting Mg tubes, were at the beginning of annealing.[Mg (Al, Zn)] was enriched by the grain boundary. All these can be clarified that in short time, the re-crystallization of roll-casting Mg sheets was relatively slow, simultaneously owing to the hexagonal crystal structure of Mg alloy, which resulted in the slower diffusion rate ofβ phase, eventually β phase could not be diffused and deposited with flake in the grains. However, the temperature of re-crystallization in combination of Mg sheet energy field was lower. The microstructure of roll-casting Mg sheets annealed at 250 ℃ for 4h is shown in Fig. 2 showed that at the annealing temperature of 250 ℃ within 4h, no obvious re-crystallization appeared in the general Mg sheet. In comparison, the chrysanthemums portion of the secondary cell dendrites, and many of the grain deformation patterns were original in the grain, and the grain shape, which was also non-uniform, distorted grain boundaries. Fig. 2b indicates, in conjunction with the energy-field Mg layer, that the majority of the cellular dendrites, clotted with chrysanthemum were dispersed into the matrix and developed a fine but inhomogeneous new nucleation.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 1, January 2017

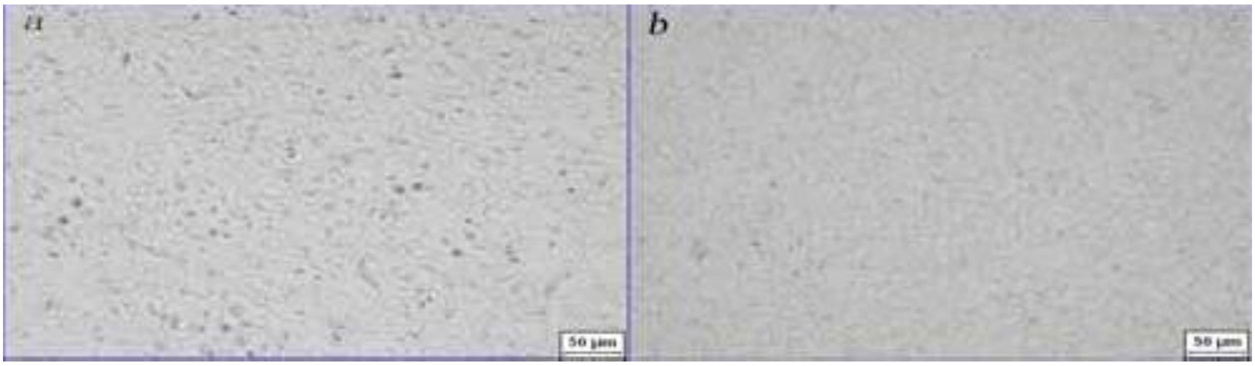


Fig. 3: The microstructure of Mg sheets at the annealing of 300℃×4h a. general Mg sheet b. combining energy-field Mg sheet

Figure shows the roll-casting microstructure of Mg sheets cleared at 300 ° C at 1 hour. 3. The Fig. 3 findings showed that the general Mg sheet, which was re-crystallized locally and combined energy field Mg sheet and decreased gradually in 4 hours, was re-crystallized under an annulling condition of 300 ° C/2h. Fig. 3b shows that the mixture of the energy-field Mg layer, kept for four hours, was similarly thin with fine grains and a uniform microstructure.
In contrast, the secondary phase, under the role of the activation heat energy, was fully dispersed and dissolved into α-Mg matrix, the grain boundaries becoming narrow and clear. Fig. 3a showed a general Mg sheet with a size of grains relatively large, but small amounts of β-phase, for four hours, which could not spread and withered at the grain borders, so a phenomenon in segregation occurred. The average grain diameter of the overall Mg sheet was 14~19 μm, 8~13 μm and combined energy Mg sheet.

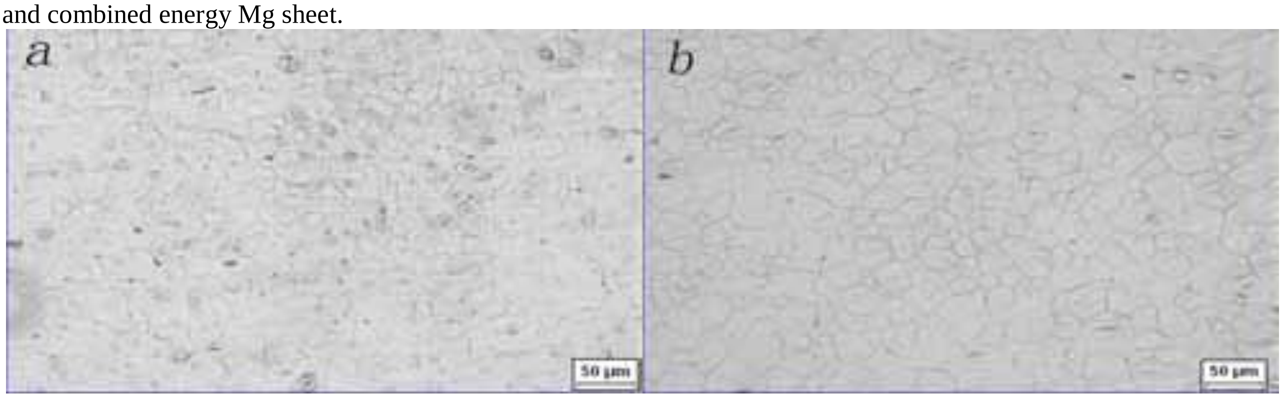


Fig. 4: The microstructure of Mg sheets at the annealing of 400℃×1h a. general Mg sheet b. combining energy-field Mg sheet

Fig. 4 shows the micro-structure of the Mg sheet, which is adorned at 400 ° C for 1h. When the Mg sheets of roll casting started to be re-crystallized in a short period of time at 400 ° C, grains began to be crushed, including tweezers. The findings in Fig. 4 showed this. It appeared in Fig. 4b that the grain diameter for 1 h was up to 50 μm, the grains arrangement was in homogenous and the twin was annealed. Fig. 4b shows the grain diameter of general Mg plate was shown to be relatively small in Fig. 4a. Most of these are attributed to the role of high temperature energy activation that increased the migration rate of new grain frontiers and phagocytized the micro-structure surrounding the initial deformation when energy distortion was ingested. However, the growth rate for grain on the Mg sheet combined energy field was faster. Holding for a 1-hour period, the average diameter of the overall Mg sheet was 20~25 μm, 28~33 μm respectively.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 1, January 2017

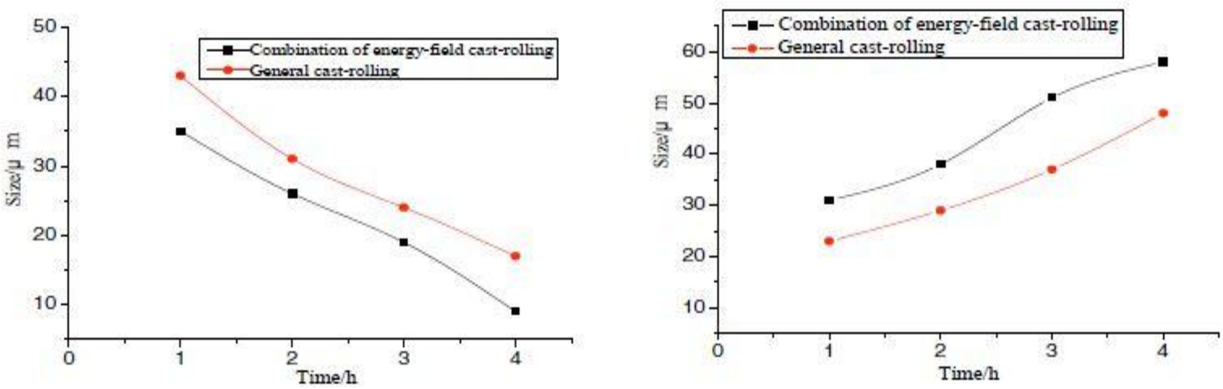


Fig. 5: the grain size of Mg sheets by annealing a. at the annealing temperature of 300℃ b. at the annealing temperature of 400℃

Fig. 5 illustrates the dependence of grain size on the rinsing time. Fig. 5 revealed that at the time of the re-crystallization, no complete re-crystallization of Mg boxes with rolling castings occurred in rolling boxes at 250 ° Within 4 hours, and the cell size decreased with the christening periods at annealing of 300 ° C. At 400 ° C, however, the cereals seemed to coarsen. On the other hand, at 300 ° C, grain size of the Mg layer was smaller than the general Mg sheet, but the same was the case with the 400 ° C flushing.

EDS analysis:

Fig. 6 demonstrates the precipitated morphology and EDS of roll-cast Mg tubes. The findings in Fig. 6 showed that on JSM— 6490LV energy dispersal spectroscopy [EDS] — independently studied the annealed Mg sheets of general roll casting and mixed energy field roll castings. The intermetallic compounds Mg17Al12, MgZn2 and Mg17 (AL, Zn) 12 have been applied to the Mg alloy with the Mg matrix. EDS reported that both Mg17Al12 phase and Mg17 (AL, Zn) 12 phase precipitate amount of annealed roll-casting Mg sheet.The inter-metallic compound stages of the Mg sheet combining energy field were reduced and granular precipitates were scattered on grain boundaries by precipitate size and morphology with the spreading of aluminum and zinc. The general Mg sheet with thicker sizes is, however, precipitated on the grain limits.

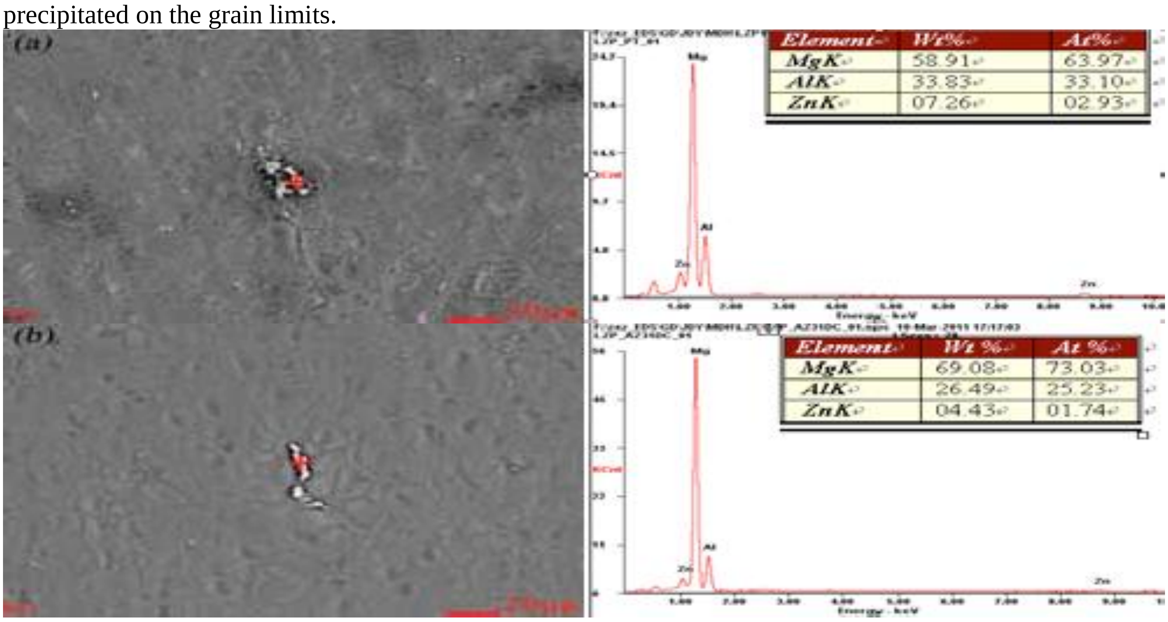


Fig. 6: Precipitate morphology and EDS of roll-casting Mg sheets (a). General Mg sheet (b). Combining energy-field Mg sheet

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: **www.ijareeie.com**

Vol. 6, Issue 1, January 2017

Annealing on the mechanical properties:

Typical AZ31B Mg alloy tensile tests have been performed and results are shown in Table 3.The findings of Table 3 revealed that the mechanical characteristically strengthened and decreased anisotropy of the annealed roll casting Mg tubes. At annealing time of 300 ° C to 4h, elongation of the combined energy-field Mg sheet decreased by 167.1%. At that time, the tensile power, yield strength and length improved respectively by 17.2%, compared with the general mg sheet, the combined energy-field Mg sheet improved by 34.1%, 74.6%. These indicated that on the other hand, combined energies cope Mg sheet was completely re-crypted and the grains of mutual occlusion increased and more grain borders, which were significantly more impeded by the movement of dislocations, finally the dislocation density had reduced. Eventually improved roll-cast Mg sheets with plastic deformation.

Table 3: Mechanical Properties of Typical Annealed AZ31B Mg Alloy

annealing process	roll-casting process	Direction	σ_b/MPa	$\sigma_{0.2}$/MPa	δ/%
before annealing	general Mg sheet	RD	228.1	156.1	2.6
		45°	211.2	132.7	2.7
		TD	202.9	128.2	2.5
	combining energy-field Mg sheet	RD	261.7	219.5	4.8
		45 °	240.5	194.5	4.7
		TD	236.2	193.3	4.5
after annealing	general Mg sheet 300℃×4 h	RD	186.2	112.4	7.8
		45 °	180.1	102.7	7.4
		TD	168.6	94.9	6.3
	Combining energy-field Mg sheet 300℃×4 h	RD	213.6	152.1	13.2
		45 °	210.1	136.8	12.5
		TD	202.7	126.9	11.7

Annealing on the hardness:

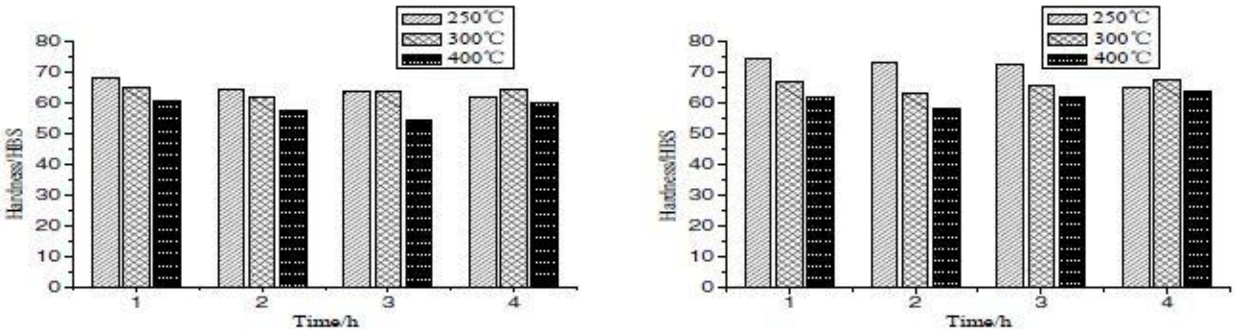


Fig. 7: The hardness of roll-casting Mg sheets by annealing a. general Mg sheet b. combining energy-field Mg sheet

Fig. 7 demonstrates the reliance on the hardness of the rinsing Mg roll castings for the rinsing time. Fig. 7 tests showed that the HB hardness values of the adorned Mg sheets were declining and the adornment temperature significantly affected the hardness, but the retention time was not apparent. The HB hardness value of integrating the Mg plate energy field under the same dynamic conditions was higher than the general Mg plate. The trend to ring within 4 hours was that the hardness value of 250 ° C HB was the highest due to a slow re-crystallization of the ringing due to low temperature, the ßen-phase was not completely dissolved, the grain boundaries were therefore smoothed, and the hardness value was lower at 400 ° CHB, which was reduced after the rising, and the roll casting of Mg s was shown.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 1, January 2017

After rising, the hardness value of 300 ° CHB decreased, anisotropy was weakened and perhaps secondary phase progressively dissolved and segregation reduced, resulting in the effect of solid solution enhancement on the matrix.

IV.CONCLUSION

The re-crystallization temperature of AZ31B Mg strips was significantly reduced, when compared with the roll-casting AZ31B Mg strips, with combined energy-field roll-casting. There was no simple recrystallization on roll casting pads, however, grains started to squeeze below the high adjustable temperature of (400) under the low change temperature of (250). The combined energy-field Mg layer, however, had thin grains and a homogenous microstructure, under the rinsing state of 300 ° C to 4h. The amount of the rolling Mg plates reduced by gluing precipitates. Nonetheless, in contrast to the integrated energy field Mg sheet it precipitates the general mg sheet with the larger size enriched at the grain frontiers. The mechanical properties were improved and anisotropy reduced by annealing of roll-casting Mg tubes.

REFERENCES

[1]J. long Zhao, Y. Xi, W. Shi, and L. Li, “Microstructure and Mechanical Properties of High Manganese TRIP Steel,” J. Iron Steel Res. Int., 2012.
[2]M. Søndergaard, E. D. Bøjesen, K. A. Borup, S. Christensen, M. Christensen, and B. B. Iversen, “Sintering and annealing effects on ZnO microstructure and thermoelectric properties,” Acta Mater., 2013.
[3]N. Hrabe and T. Quinn, “Effects of processing on microstructure and mechanical properties of a titanium alloy (Ti-6Al-4V) fabricated using electron beam melting (EBM), part 1: Distance from build plate and part size,” Mater. Sci. Eng. A, 2013.
[4]H. Zhang, Y. Pan, and Y. He, “Effects of annealing on the microstructure and properties of 6FeNiCoCrAlTiSi high-entropy alloy coating prepared by laser cladding,” Journal of Thermal Spray Technology. 2011.
[5]Z. Lin, W. Cai, W. Jiang, C. Fu, C. Li, and Y. Song, “Effects of annealing temperature on the microstructure, optical, ferroelectric and photovoltaic properties of BiFeO3 thin films prepared by sol-gel method,” Ceram. Int., 2013.
[6]Z. J. Xie, G. Han, W. H. Zhou, C. Y. Zeng, and C. J. Shang, “Study of retained austenite and nano-scale precipitation and their effects on properties of a low alloyed multi-phase steel by the two-step intercritical treatment,” Mater. Charact., 2016.
[7]N. Zotov, M. Bartsch, L. Chernova, D. A. Schmidt, M. Havenith, and G. Eggeler, “Effects of annealing on the microstructure and the mechanical properties of EB-PVD thermal barrier coatings,” Surf. Coatings Technol., 2010.
[8]H. F. Xu et al., “Heat treatment effects on the microstructure and mechanical properties of a medium manganese steel (0.2C-5Mn),” Mater. Sci. Eng. A, 2012.
[9]B. Wang, X. H. Chen, F. S. Pan, J. J. Mao, and Y. Fang, “Effects of cold rolling and heat treatment on microstructure and mechanical properties of AA 5052 aluminum alloy,” Trans. Nonferrous Met. Soc. China (English Ed., 2015.
[10]H. Luo, H. Dong, and M. Huang, “Effect of intercritical annealing on the Lüders strains of medium Mn transformation-induced plasticity steels,” Mater. Des., 2015.
[11]M. Wang, B. Song, Q. Wei, Y. Zhang, and Y. Shi, “Effects of annealing on the microstructure and mechanical properties of selective laser melted AlSi7Mg alloy,” Mater. Sci. Eng. A, 2019.
•S Balamurugan, RP Shermy, Gokul Kruba Shanker, VS Kumar, VM Prabhakaran, “An Object Oriented Perspective of Context–Aware Monitoring Strategies for Cloud based Healthcare Systems”, Asian Journal of Research in Social Sciences and Humanities, Volume : 6, Issue : 8, 2016
•S Balamurugan, P Anushree, S Adhiyaman, Gokul Kruba Shanker, VS Kumar, “RAIN Computing: Reliable and Adaptable Iot Network (RAIN) Computing”, Asian Journal of Research in Social Sciences and Humanities, Volume : 6, Issue : 8, 2016
•Kavita Arora, Kavita, Vishal Jain, Impacts of Black Hole Attack on Mobile Ad-hoc Networks, International Journal of Future Generation Communication and Networking, Vol. 13, No. 4, (2020), pp. 644–653
•Gomathy, V., Padhy, N., Samanta, D. et al. Malicious node detection using heterogeneous cluster based secure routing protocol (HCBS) in wireless adhoc sensor networks. J Ambient Intell Human Comput (2020). https://doi.org/10.1007/s12652-020-01797-3.
•Kamlesh Kumar Rana, Vishnu Sharma, Vishal Jain, Sanjoy Das, Gagan Tiwari and Vikram Bali, “Directional Location Verification and Routing in Vehicular Ad-Hoc Network”, IoT and Cloud Computing Advancements in Vehicular Ad-Hoc Networks, IGI-Global, March, 2020, ISBN13: 9781799825708, DOI: 10.4018/978-1-7998-2570-8.ch001.