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Review on Mg Alloys Metallurgical Structure under Severe Plastic Deformation (SPD)

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Abstract: Magnesium (Mg) alloy sheets are high cost and having formability at poor room temperature limits the applications in feed Stock pressing output of Mg sheets is normally achieved by squeeze casting and extreme plastic deformation (SPD). This SPD process reduces production costing and improves formability. The present work is done on AZ31 Mg size plate 96*96*4 mm Usage of a new melt transfer technique, with forging power 180 Ton and 200mm / sec. after partial homogenization, the mechanical properties of squeeze-casted Mg plate under SPD were investigated.
Keywords: AZ31 Mg, SPD, Microstructure.

I. INTRODUCTION

Mg and alloys are light in weight, good combination of engineering properties, having several structural and super-sensitive features made them to use in several engineering applications. However, because they are having low formability, unfortunately these can't be used where certain applications requires high plastic deformability to make them to achieve desired configurations and or shapes. Mg and its alloys rank in metallic content The method is most complicated and difficult to scientifically reconcile. Bottom line, the Mg alloys exhibits, HCP crystal structure and low stacking fault energy (SFE) in large part because of low ductility. This type of innate material characteristics in Mg and its alloys have regrettably limited wide spread in applications. Hence, several researches aiming and putting efforts in Exploring manufacturing techniques to make certain alloys more formable and The use of controlled engineering has been published, and continues to be.

This paper explores fundamental aspects metallurgical mechanical behavior, specifically plasticity characteristics of Mg alloys. It also offers a succinct overview of different processing routes like Standard alloy shape, and extreme plastic deformation (SPD).

II. MG AND ITS ALLOYS COMPONENTS

In the Al, Mg and Ti group and in the entire metallic materials family, the lightest structural metals are the magnesium and its alloys. They possess high specific strength, stiffness and some other rare combination of engineering properties Strong castability, decent ability to electromagnetic shield, good machinability and good weldability etc. They also have dimensional stability, Strong efficiency with damping, good biocompatibility and quick recycling. Hence, these are having vast applications When designing e-consumer goods such as faults for digital camera, computer and smart phones etc., and Conventional construction materials in transport business like automobile parts, Components of a commuter rail and aircraft etc.,

III. RESTRICTIONS ON MG AND ITS ALLOYS

The Mgs alloy applications had been far from reachable if they do possess nice deformable plastic. Because of this diverse properties, Mg alloys has embittering limitation. HCP crystal structure in this Mg alloy makes this material difficult under plastic deformation, hence this high plastic deformation resistance, making it difficult for Mg alloys to form in appropriate forms. Several researches and methods are attempted and still attempting enhancing formability properties and mechanical characteristics for this Mg alloys to make use of them in wider applications of engineering.

IV. PROCESSES ON FORMABILITY

Forging, rolling, extrusion and alloying are the general common conventional processing methods to enhance and explore The formability of the alloys and Mg. The Extreme Deformation of Plastics (SPD)

is the latest one to change the various properties for this material. The methods relay on a detailed analysis and understanding of the metallurgical structure of Mg alloys and their effect on mechanical behavior. From literature survey it was clear that, several researches have been done on Mg alloys and these alloys leverage advantages in different structural applications. Mostly the Mg alloys with combination of cast and wrought alloys type The most commonly alloys Mg utilization and boundaries for automobiles

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parts engineering have been reviewed. The most recent works are reviewing on improvement of properties for Mg alloy with wrought iron combination on formability processes like pre-twinning, alloying and SPD. Nevertheless, succinct reviews with a detailed feature covering Mg's metallurgical structures and alloys, processing methods to boost formability and their limitations The effect of metallurgical structures on characteristics of plastic deformations etc., are available. This present research reviews and aims to provide thorough reading for those interested in Mg and its alloys, with focus on past and current approaches to the production of Mg alloys with enhanced formability.

V. METALLURGICAL STRUCTURE FOR ALLOYS MG

Mg alloys are graded for engineering and testing purposes on the basis of their processing system as cast Mg alloys and Mg alloys. The cast Mg alloys are made from the cast die and the commercial and industrial application methods are used the other casting methods over the last decades. Even though the usage of die cast goods Mg alloy is more, they are used limitedly in areas where Stable thermal conditions and moderate mechanical properties are required specifically. The wrought Mg alloys along with cast Mg alloys are having superior mechanical properties. This attribution, therefore, has a Uniform composition and marked precision of grain, free of pores. They were made available by Wrought Mg alloys have superior properties in several applications such as window seat frames. In other hand the applications of this wrought Mg alloys is limited and restricted due to formability and poor ductility That results from crystal structure of HCP and blame for low energy stacking.

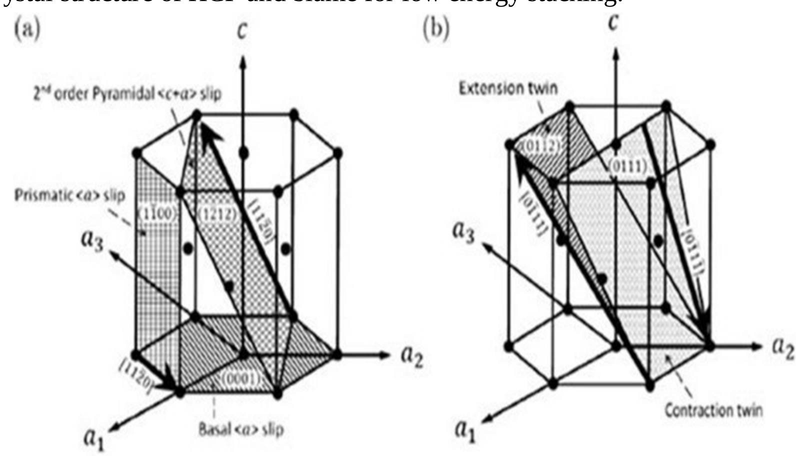

Fig-1 Crystal structure of mg alloys

VI. MG STRUCTURAL CHARACTERISTICS

The HCP crystal structures with low symmetrical characteristics are possessed by Mg and its alloys. The parameters of these alloys are a = 3.18 Å and c = 5.19 Å and a c / a ratio of 1.62354 (at 25 ° C) slightly below 1.633 ideal c / a ratio for HCP structures. This near ideal function of c / a Ratios results in higher concentrations of primitive cells compared to other HCP metals leading to low rates of stacking energy (SFE) in Mg alloys. The SFE are called Crystalline blemishes, which results due to removal or introduction of a sequence of atomic layers of atomic arrangements the stacking energy (SFE) is established inside a crystal metallurgical system and the energy per unit area of the faults. The SFE is a very important utility parameter for quantifying various mechanisms of deformation to metal, such as Energies for device activation of deformation in SFE level regulated metals. The SFE depends on various factors such as local faults, dislocation configuration and grain size as well the SFE varies from one atomic plane to another atomic plan. The lower SFE increases the activation energies for slip and favour in twinning deformation while the high SFE decreases the activation energies for dislocation movement and therefore favors slip.

Consequently, because of such low SFE of Mg alloys and other HCP metals, such metals contribute to the disadvantage of ductility. Furthermore, the HCP structure has around 6 independent slip parameters, out of which only two slip systems are slip movement-oriented. The six slip structures are: one {0001} <11–20 >, one {10–01} <11–20 >, one {10–11} <11–20 >, c + one {11–22} <11–23 >, one {10–10} <0001 >. There are small numbers of favorably directed crystallographic directions and planes for slip motions, which are due to low symmetry for the HCP lattice, rendering strain accommodation in this crystal structure difficult. It is also very important to note that the mechanisms of deformation in HCP metals depend on slip and twinning critically resolved shear stress (CRSS), c / a ratio, functional mode of deformation, and the deformation imposed relative to crystallographic texture.

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VII. AM SERIES ALLOY

Alloys AM are the composition of Al and Mn with greater Al concentration such examples are AM30, AM40, AM50 and AM60. These alloys are having superior extrudability generally compared to AZ alloys, since Zn is absent. The Zn contains The ternary eutectic phases possess superior mechanical properties. These Mg alloys have the mechanical properties such as AM30, AZ31 etc., are extrusion velocities and temperatures significantly affected as per the reports, generally, the low extrusion speeds foster greater dynamism recrystallization, that results in improved grain structures and properties. Due to the weaker basal pole splitting and basal textures in AM60, Huang et al, also documented greater potential for stretch formability in AM60 alloy materials compared to AZ61 alloys. Because of weaker basal pole splitting and basal hardness in AM60 compared with AZ61 alloys. The alteration of the texture in this alloy happened after annealing

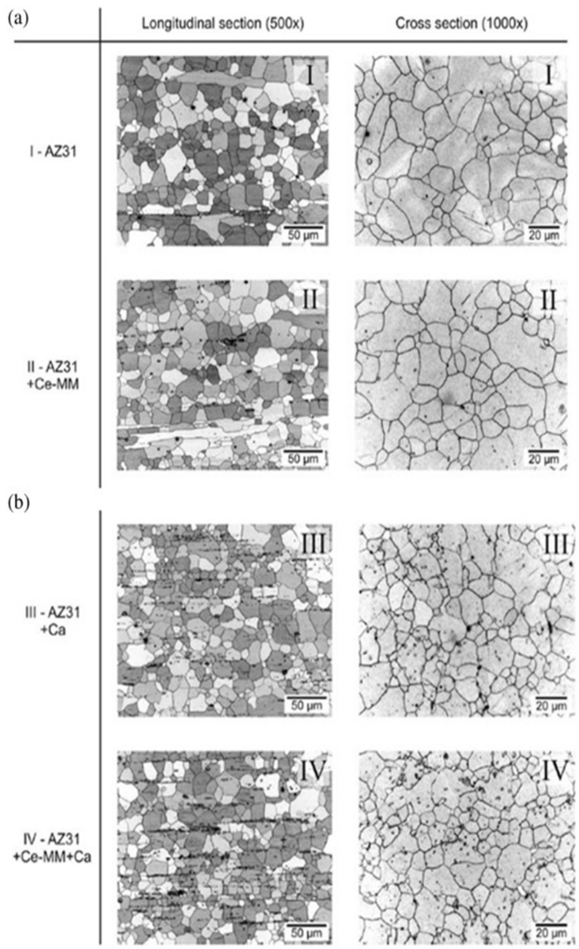

Fig 2: Micro structure of Mg alloys after SPD

and they were allotted in technology of newly generated static recrystallized grains at pre-existing grain boundaries and the presence On pre-existing static recrystallized grains of deformation twins. Huang et al studied the effect of Al concentrations on the texture and formability of different AM alloys (AM30, AM40, AM50, AM60, AM70 and AM80) in sheets. From the observations, it is clear that the AM alloys with low concentrations of Al (about <6%) had lower formability and strong in basal textures compared to high Al concentrations (>6%). And this high concentration AM alloys are having high enhanced strength. From the studies it is clear that the AM50 alloy Mechanical Properties will increase with

introduction of Ce and Y at elevated and room temperatures. The change has been attributed to the A12Y and Al 11 Ce3 precipitates. They formed upon the addition of Y and Ce to this alloy. The above precipitates are showed in improvement in grain refinement in the structure as per reports related to grain growth. It is important to note that in spite of the potential of AM alloys in cast and wrought applications, as in AZ Mg alloys, the effect of non-RE and RE elements on the formability of room temperature for AM alloys has been sparsely studied.

VIII. CONCLUSIONS

From the observations it is clear that the microstructures two cycles later for groove pressing, at the dropping temperatures from 543K to 493K. It displays that an essential refinement of the grains can be observed from 39 to 4.7 µm. from the study it is clear that the hardness was increased approximately from 25% from 56 to 74.1 under Vickers hardness test. Improving mechanical strength is evident as a result of both work hardening and grain refining. The findings show that when combined with groove pressing the casting is squeeze is potentially an effective method for preparing Small alloy magnesium plates with a fine grained structure and better mechanical properties.

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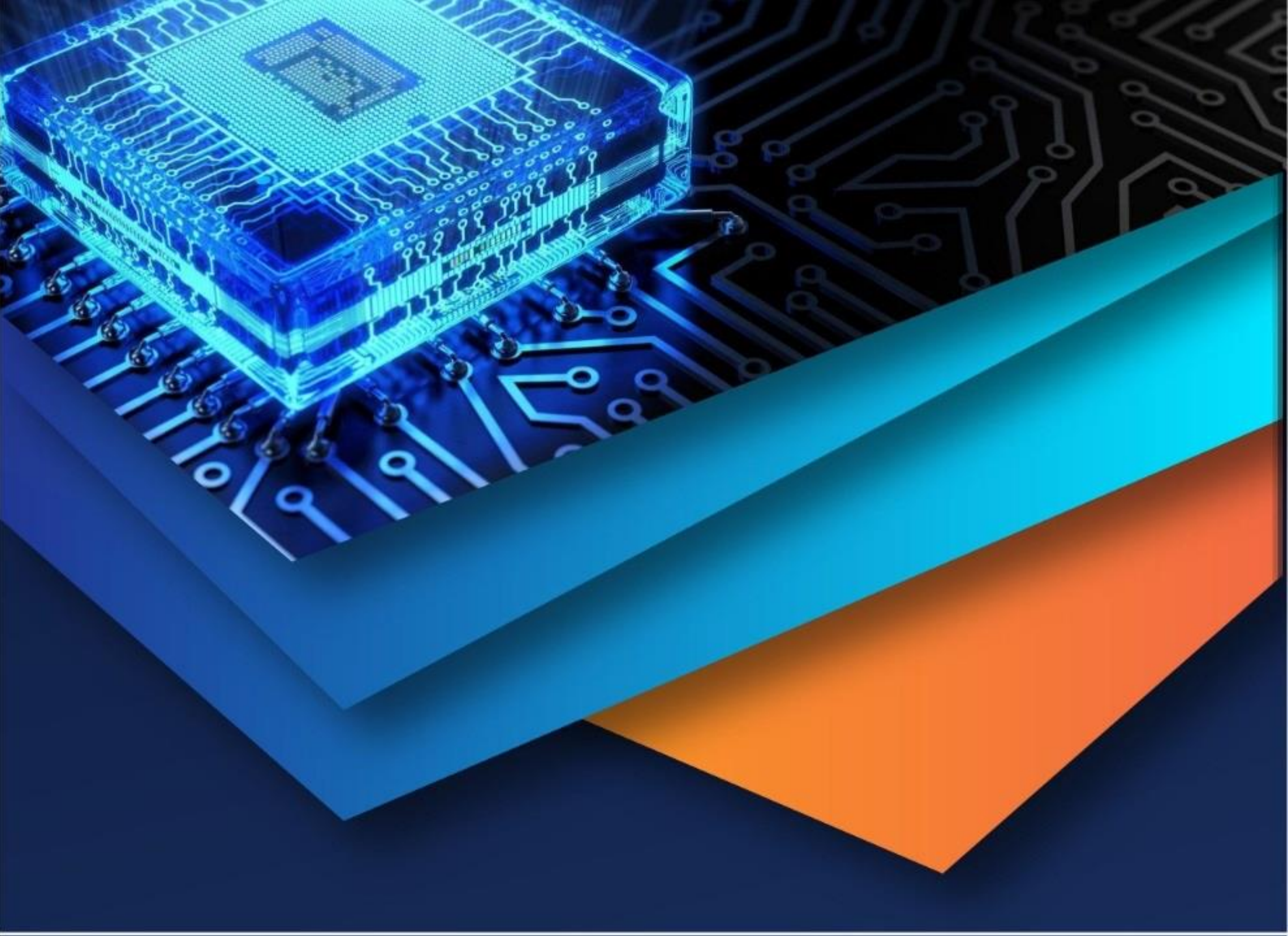

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