Mechanical Alloying of Aluminium Alloys With Different Metal Alloys And Their Characteristics

Velmurugan.T[1], Alagu pandian.S[2], Althaf ahamed.F.S[3], Arunkumar.A[4]
Sri Ramakrishna Engineering College

Abstract- *Mechanical alloying is a solid state powder processing technique in which two or more metal powders are mixed together and compacted with a high energy ball milling technique , it is mainly developed to overcome the disadvantage of powder blending. Mechanical alloying is used to produce a homogenous metal structure. The grain size can be better controlled by mechanical alloying and powder metallurgy. It can produce variety of phases in equilibrium and non equillibrium state. The paper mainly deals with mechanical alloying and powder metallurgy and their effects in the aluminium alloy mixed with various metal alloys at different composition. The results state that mechanical alloying and powder metallurgy can produce homogenous metal structure and multilevel metal structure can be created.*

Keywords- mechanical alloying (MA), powder metallurgy, aluminium alloys.

I. INTRODUCTION

Mechanical alloying is a solid state powder processing technique in which two or metal powders are mixed with different composition compacted in high energy ball mill and then sintered in a particular temperature. Alloy produced through mechanical alloying have homogenous metal structure.metal powders were fractured and rewelded together in a high energy ball milling operation leads to formation of a new metal alloy followed by sintering process. The microstructure of the alloys can be examined by XRD, SEM. The microstructure of such produced alloys have been better compared to other conventional methods of producing metal alloys.

II. LITERATURE SURVEY

The literature consists of work conducted on various aluminium metal alloys by powder metallurgy and mechanical alloying process. The study consists of various composition of aluminium alloys produced through powder metallurgy and their effects on them. The literature is in the tabular form given below.

S. NO	TITLE OF PAPER	AUTHOR	IMPORTANT POINTS	INPUT PARAMETER	OUTPUT PARAMETER	FINDING
1	Mechanical alloying	J.S. Benjamin	Mechanical alloying overcomes the disadvantages of powder blending. Metal powder was repeatedly flattened, fractured. Homogenous metal structure.	Compacting-high energy ball mill followed by heat treatment process. Nickel-64%, chromium-20%, Ni-Ti-Al-15%, yttrium oxide-1%. Heat treatment at 2400 degree F.	Metal powder particles are fractured and welded together. To gain maximum high temperature strength the grain must be induced to recrystallize to make them coarser.	Multilevel metal composite. Mechanical alloying used in the production of dispersion strengthened super alloys. More complex dispersion strengthened nickel base alloys can be made.
2	MECHANICAL ALLOYING - A NOVEL METHOD	D. OLESZAK	Mixing powders of different materials to produce entirely new alloys and compounds which do not normally	Fe and Al with a purity of 99.9% and particle sizes of 100 and 40 μm, respectively.	XRD patterns of the Fe — 50 at.% Al powder mixture subjected to milling for	Resulted in the formation of supersaturated bcc Fe(Al) nano crystalline

	FOR SYNTHESIS AND PROCESSING OF MATERIALS		form at room temperature or by conventional process. Inter metallic compounds are manufactured by mechanical alloying. Prepare nano crystalline alloys and compounds.	Ball mill speed 120 rev/min. Cylindrical stainless steel vials of inner diameter 130 mm and height 128 mm. The ball-to powder weight ratio 50:1.	increasing time. The value of lattice parameter a of this Fe(Al) after 600 h calculated reaches 0.2935 nm, compared with 0.2867 nm for pure Fe.	solid solutions. Processes performed for Al-rich powder mixtures resulted in the formation of an amorphous phase. The crystallization temperatures range 600-800 K.
3	Effect of processing of mechanical alloying and powder metallurgy on microstructure and properties of Cu–Al–Ni–Mn alloy	Zhu Xiao a et al	Cu-based shape memory alloys are very cheap. Cu–Al–Ni alloy has higher thermal stability than that of Cu–Zn–Al alloy addition of Mn in Cu–Al–Ni SMA and enhances the thermos elastic and pseudo elasticBehaviors. The grain size and composition can be better controlled by using the fabrication process with mechanical alloying (MA)and powder metallurgy	Preparation of pre-alloyed powders. Vacuum heat pressing and hot extrusion. Shape memory effect measurement. XRD profile of powder milled for different times. A strip specimen 20mm×2mm×0.5mm treated at 850 ◦C for10 min followed by quenching into room temperature.	Compact fabricated from powder mixtures milled for 50 h at 300 rpm without PCA by vacuum heat pressing and hot extrusion at extrusion rate of 50:1. A small amount of milled powders was removed after certainmilling time from the container in anargon glove box and investigated using X-ray diffraction (XRD).	The milling speed and process control agent have some effects on the pre-alloying course and themicrostructure. When milling time increases ,the positions of Cu diffraction peaks move towards low-angle, the width of Cudiffraction peaks broaden, and the size of crystallite graindecreases . homogeneous compact with crack- and pore-free can be obtained.
4	AlNiCrFexMo0.2CoCu High Entropy Alloys Prepared by Powder Metallurgy	Fan Yuhu et al	HEAs (high entropy alloys) are composed of multi principal elements inequimolar or near-equimolar ratios. HEAs are mostly prepared by the method of arcsmelting and casting. AlNiCrFexMo0.2CoCu (x=0.5, 1.0, 1.5 and 2.0) high entropyalloys were prepared by Powder metallurgy.	Alloys are mixed for 8 hrs then compactedat 310 MPa in a cold uniaxial pressing. The specimens were sintered at 500 °C for 30 min firstly, then the temperaturewas raised to 1300 °C at the speed of 10 °C/min for a sinteringtime of 120 min. XRD,SEM,EDS.	According to the XRD analysis, it is the decreased volume fraction of hard σ phase andincreased volume fraction of soft FCC phase that leads to the improvement of HEAs' plasticity. The hardness and relativedensity of alloys decrease with the increase of Fe content.	The microstructure of alloyschanges from bcc+fcc+σ at x=0.5, 1.0 and 1.5 to bcc+fcc atx=2.0. With the increase of Fe content, the size of σ phasedecreases gradually, but fcc phase improves. All AlNiCrFexMo0.2CoCu alloys have a good plasticity.
5	Evaluation of the mechanical properties of powder metallurgy	L. Bolzoni et al	Titanium and its alloys are common biomedical materials owing to their combination of mechanical properties, corrosion resistance and	The Nb:Al:Ti masteralloy was in the form of granules (maximum particle size < 800 μm) and had a ratio	Vickers hardness measurements by means of a Wilson Wolpert Universal Hardness DIGITESTOR	Irregular hydride-dehydride powders can successfully be shaped into pressed components which can be handled

	Ti-6Al-7Nb alloy		biocompatibility. The sintering of the Ti-6Al-7Nb alloy induces a total shrinkage between 7.4% and 10.7% and the level of porosity decreases from 6.2% to 4.7% with the increment of the sintering temperature. The production of the Ti-6Al-7Nb alloy by PM techniques has been done considering different methods like hot-press and injection moulding.	between the elements of 60:35:5 (percentages in weight). Sintering temperature range between 1250ºC and 1350ºC, dwell time at maximum temperature of 120 min and heating/cooling rates of 5ºC/min.	930 tester performing HV30 measurements. Ultimate tensile strength (UTS) and elongationusing a MicroTest universal machine equipped with a load cell of 50 KN and a Hottinger Baldwin Messtechnik, type DD1 extensometer.	without fracture. The total shrinkage increases from 7.4% to 10.7% and the porosity levels decreasesfrom 6.2% to 4.7% with the increment of the temperature. Alternative for the manufacturing of non-critical and structural biomedical Applications.
6	Dispersion of silicon carbide nanoparticles in a AA2024 aluminum alloy by a high-energy ball mill	C. Carreño-Gallardo a et al	Particle-reinforced metal matrix composites (MMCs) exhibit improved mechanical and physical properties which combine the advantages of both the matrix and the reinforcing materials. Aluminum and its alloys have been reinforced with ceramics in order to improve properties like wear behavior or mechanical strength.	Aluminum alloy AA2024 (Al–4.00% Cu–0.83% Mg–0.21% Fe–0.67% Mn–0.12% Si–0.03% Cr) High energy ball mill SPEX 8000M. After sintering, the specimens were treated using a heat treated solution for 1 h at 495 c.	The cylindrical shaped compression specimens were tested by using the compressive test with a constant strain rate of 10^{-3} s. the yield stress was determined at the 0.2 pct offset. The XRD pattern for the sintered sample illustrates a refinement in the signals of the aluminum solid solution.	SiC nanoparticles can be uniformly incorporated into AA2024 matrix by a milling process. Hardness, yield strength and compressive strength of nanostructured AA2024 composites increased with increasing SiCNP content Short milling times (2 h) gave the best response on the mechanical properties of composites.

III. CONCLUSION

1. Multilevel metal composite can be created by mechanical alloying.
2. Mechanical alloying used in the production of dispersion strengthened super alloys
3. Cube milling was proven to be six times faster than planetary ball milling.
4. The powder metallurgy technique can be used to produce pure aluminum Nanocomposite in which the nano TiO2 particles are uniformly distributed within the matrix alloy with a low degree of porosity.
5. The plasticity was also improved with a low Ni content.
6. The mechanical properties are strongly dependent on heat-treatment condition.

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