IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Comparison Analysis Of SEM With ECAP And Stir Casting Using Different Ratio Of Aluminium And Boron Carbide

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Abstract:* *This experiment, comparison analysis of micro structural properties, and grain size of Pure Al (powder), 95%AL + 5% B_4C and 90%AL + 10% B_4C (With ECAP method & stir casting) are determined. Based on the micro structural analysis using SEM, the particle distributions of AL- B4C were analysed. The powdered sample were fabricated using equal channel angular pressing (ECAP) and stir casting process. When observed using SEM it was found that the particle distribution homogeneity increased as the number of passes increased from one to four. The factors such as Temperature, number of passes are to be considered in the development of grain structure and refinement. The results show that: the amount of shear strain and the mobility of metal matrix have the most important influence to the uniform distribution of particles Al− B_4C. In this work, the mixtures of B_4C particles and Al powders were fabricated into sever plastic deformation using ECAP and stir casting. And the effects of different ratios, positions and deformation stages on the distribution of B_4C particles were investigated.

Keywords: ECAP; SEM; Boron Carbide; Grain Size; aluminum; hardness

1. Introduction

In the SEM just thin specimens, which permit a small amount of the episode electron beam to experience the specimen can be examined. At the point when a quickened light emission encroaches upon a specimen a rich assortment of co operations happens. The adaptability of electron microscopy and x-beam microanalysis is gotten in huge measure from this assortment of communications that the shaft electrons experience in the example. The communications that happen amid the impact of the electron bar and the test incorporate specifically transmitted electrons, backscattered electrons, auxiliary electrons, lucid flexible scattered electrons, muddled inelastic electrons, incomprehensible versatile forward scattered electrons.

Equal- channel angular pressing (ECAP) is one of the late metal framing process and a known system in the manufacture of metals and alloys. It plays a fundamental part in the microstructural refinement and the squeezing operation. The huge elements of the microstructures created by ECAP in late materials with the single stage, multi-stages and metal-lattice composites. It is important to advance an extensive variety of small scale auxiliary parameters and it incorporates the grain limit confusions, the crystallographic composition and the circulations of any second stages. The fundamental target time is to add to a metal shaping procedure where high strains might be brought into metal billets by basic shear. The different sorts of ECAP have been created and connected in the generation of ultrafine-grained structures

Stir casting process involves a mechanical stirrer is introduced to form vortex to mix reinforcement in the matrix material. It is a suitable process for production of metal matrix composite due to its cost effectiveness, simplicity, almost net shaping and easier control of composite structure. The furnace is used to heating and melting of materials. The bottom poring furnace is more suitable for the stir casting of the mixture slurry instant poring is required to avoid the settling of the solid particle in the bottom the crucible. The mechanical stirrer is used to form the vortex which lead the mixing of the reinforcement material which are introduced in the melt. Stirrer consist of the stirring rod and impeller blade. The impeller blade may be of, various geometry and various number of blades. Flat blade with three number are the preferred as it leads to axial flow pattern in the crucible with less power consumption. This stirrer is connected to the variable speed motors, the rotation speed of the stirrer is controlled by the regulator attached with the motor. Further, the feeder is attached with the furnace and used to feed the reinforcement powder in the melt. A permanent mold, sand mold or a lost-wax mold can be used for pouring the mixing slurry.

The fantastic thermal stability and exceptional substance inertness are an alluring reinforcing operators for aluminum-based composites. Boron carbide (B4C) is the third hardest material lesser than diamond and cubic boron nitride. It has a low density (2.52g cm-3), high level of chemical inertness, high temperature, and incredible thermo-electric properties. The nuclear structure of boron carbide is fairly one of a kind. This surprising structure and holding is in charge of the fabulous thermo mechanical properties of boron carbide. In this manner, it is making a decent substitute for some applications. The broadly acknowledged structure of boron carbide is rhombohedra with boron icosahedra. It can be utilized as a type of powder, sintered item and also thin movies and different applications, for example, covered cutting instruments defensive layer. It utilizes as a part of manual and vehicle security and defensive covering for electronic instruments. Another vital normal for boron carbide is a high neutron assimilation limit which it makes appealing for neutron-protecting applications. Boron carbide (B4C) which has a low thickness, hardness just beneath the thickness of precious stone. B4C-Al composites are compelling potential materials to be utilized for the effect applications. The high cost of B4C powder confines their far reaching use. The writing reports are the impacts of Al and B4C particles composite as fortified AMCs at lifted temperatures. Subsequently, this paper points are to assess the impacts of the ECAP on the mechanical properties of Al composites fortified with B4C particles. The impact of hardness, thickness, grain size and porosity is likewise inspected.

Fig. 1
ECAP total die setup

Fig. 2
ECAP plate with 900angle plate

2. Sample preparation

ECAP preparation

In this work, for the preparation of ECAP sample is prepared by mixing of 500g aluminum with 15g boron carbide and 500g aluminium with 50g boron carbide for the 2 proportions. These two powders are mixed properly with the correct ratio of the process of ball milling machine. The composite powders are filled in aluminium capsules of 12mm diameter and plunged. Then the capsules are placed in ECAP die and prepared sample size 12x56 with one pass only.

Fig. 3 ECAP Preparation

3. STIR CASTING PREPARATION

Fig. 4 Stir Casting Preparation

The mechanical stirrer is used to form the vortex which lead the mixing of the reinforcement material which are introduced in the melt. Stirrer consist of the stirring rod and impeller blade. The impeller blade may be of, various geometry and various number of blades. Flat blade with three number are the preferred as it leads to axial flow pattern in the crucible with less power consumption. This stirrer is connected to the variable speed motors, the rotation speed of the stirrer is controlled by the regulator attached with the motor. Further, the feeder is attached with the furnace and used to feed the reinforcement powder in the melt. A permanent mold, sand mold or a lost-wax mold can be used for pouring the mixing slurry.

4. SEM sample preparation

Fig.5
Mixed ratio of 95%Al and 5% B_4C

SEM is a microscopy strategy whereby a light emission is transmitted through a ultrathin example, interfacing with the specimen as it goes through it. A picture is shaped from the electrons transmitted through the example, amplified and centered by a target lens and shows up on an imaging screen, a fluorescent screen in many SEMs, in addition to a screen, or on a layer of imaging plate, or to be identified by a sensor, for example, a CCD camera. Natural materials contain extensive amounts of water. To have the capacity to view it in the electron microscopy, the principal stage in planning is the obsession, a standout amongst the most imperative and most basic stages. We have to settled it in a way that the ultrastructure of the cells or tissues stay as near the living material as would be prudent. The example is then got dried out through a ethanol arrangement, went through a "move dissolvable, for example, propylene oxide and afterward penetrated and installed in a fluid tar, for example, epoxy and LR White sap. In the wake of installing the sap square is then thin segmented by a procedure known as ultramicrotomy, segments of 50 - 70 nm thickness are gathered on metal cross section "networks" and recolored with electron thick stains before perception in the SEM. Segmenting the specimen permits us to take a gander at cross-sections through examples to see inward (ultra)structure.

5. RESULT AND DISCUSSION:

IN SEM images , there is a conjugate correspondence between the pattern of the specimen and rastering pattern used to produce the image on the monitor. The signal produced by the rastering is collected by detector and subsequently processed to generate the image. The processing take the intensity of the signal coming from a pixel on the specimen and converts it to a grayscale value of the corresponding monitor pixel. The monitor image is a two-dimensional rastered pattern of grayscale values.

Therefore, the beam must be focused to a diameter between 0.5 to 0.7 times the diameter of the magnification. Constract C involves the signals produced by the detector for two points A & B on the sample, the number of these electrons reaching the detector, and its efficiency to record them. The signal produced by the detector can be modified to change the appearance of the image, however such change does not alter its information content.

Ratio: 95%AL + 5% B_4C

Here Al and B_4C is mixed in the ratio of 95:5 in ball milling and sample has been prepared and processed with ECAP & stir casting and SEM analysis has been taken. The results are given below for showing the bonding of powders from ECAP.

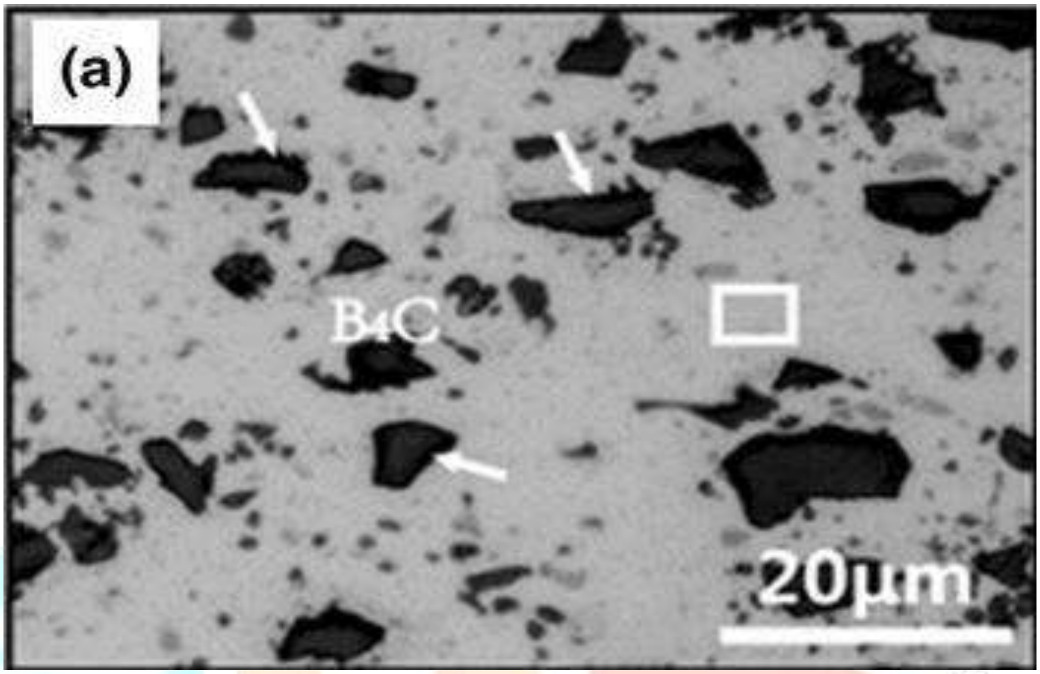

Fig.6
Mixed ratio of 95%Al and 5% B_4C

Ratio: 90%AL + 10% B_4C

Here Al and B_4C is mixed in the ratio of 90:10 in ball milling and sample has been prepared and processed with ECAP & stir casting and SEM analysis has been taken. The results are givenbelow for showing the bonding of powders from ECAP.

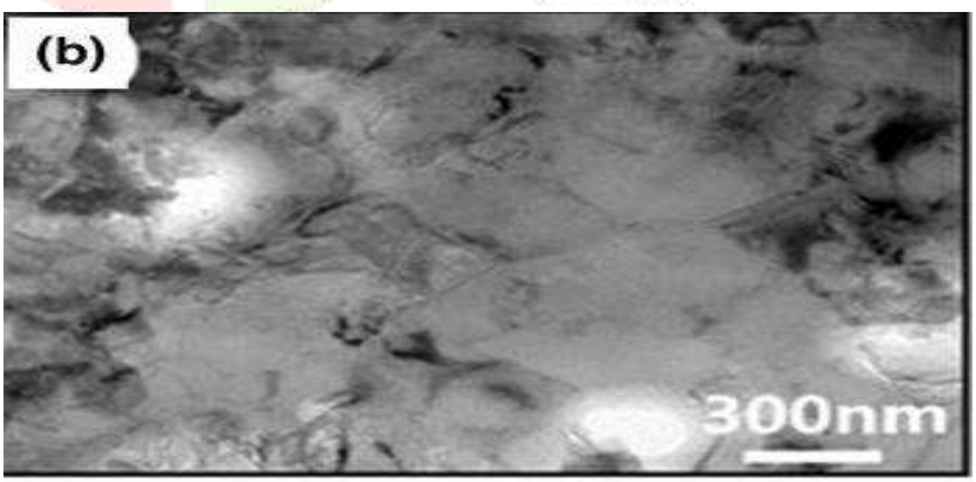

Fig.7
Mixed ratio of 90%Al and 10% B_4C

6. CONCLUSIONS

- ECAP was successfully used to process Al, Al- 5 wt% B_4C composite and Al- 5 wt% B_4C composite powder up to 4 passes through processing route A.
- .Stir casting process was successfully used to produce the product and Comparison of both ECAP and stir casting product, the ECAP product is better.
- ECAP of Al- 5 wt% B_4C composite have better mechanical properties and microstructure compared to that of CP Al, Al- 5 wt% B_4C composite powder.
- The improvement in mechanical properties of ECA pressed Al-5 wt% B_4C composite was mainly attributed to pore closure, grain refinement and high density of dislocations in the microstructure and the distribution of B_4C particles were uniform throughout the microstructure.
- The density of Al- 5 wt% B_4C and Al- 5 wt% B_4C composite powder attained after 4 ECAP passes were near to calculated theoretical density of the composite.
- The average grain size and porosity of Al- 5 wt% B_4C composite and Al- 5 wt% B_4C composite powder decreased as ECAP passes were increased.

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