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EXPERIMENTAL STUDY OF 5083 ALUMINIUM ALLOY PROCESSED BY FRICATION STIR PROCESSING

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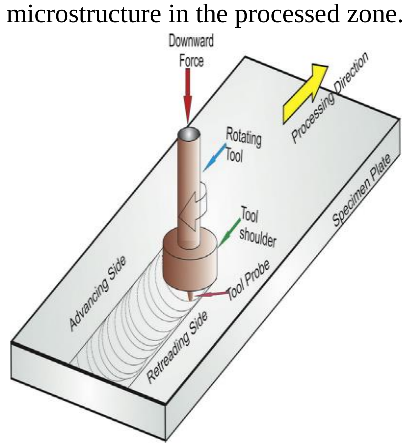
Abstract- **The Aluminum matrix composites (AMCs) are emerging as advance engineering materials due to their strength, ductility and toughness. The aluminum matrix can be strengthened by reinforcing with hard ceramic particles like Sic, Al_2O_3,B_4C etc. In the present study, an effort is made to enhance the mechanical properties like tensile strength and hardness of AMCs by reinforcing 6061Al matrix with B_4C particles. By stir casting route, aluminum matrix was reinforced with boron carbide particulates of 37, 44, 63, 105, 250μ sizes respectively. The microstructure and mechanical properties of the fabricated AMCs was analyzed. Based on the results obtained from tensile strength test of the metal matrix composites of different particle sizes, 105μ size B_4C was chosen and varied the wt% of B_4C with 6,8,10 and 12wt%. The optical microstructure images reveal the homogeneous dispersion of B_4C particles in the matrix. The reinforcement dispersion has also been identified with X-ray diffraction (XRD). The tensile strength and hardness was found to increase with the increase in the particle size and also with the increase in wt% of the reinforcement**

I. INTRODUCTION

Surface composites exhibit enhanced characteristics of composites on the surface while retaining properties of the base material Friction stir processing. FSP is one of the techniques for fabricating surface composites and modifying micro structural features. The friction stir processing is derived from the friction stir welding process. It is a novel material process technology by which Mishap in 1999 which was originally used in the material of super plastic material. Friction stir welding and Friction stir processing have both are similarly same process and principle.FSP in its simplest form consists of a non-consumable rotating tool, which is plunged into a work piece and then moved in the direction of interest. The tool serves two primary functions: (a) heating and (b) de0formation of work-piece material. The heat is generated mainly by the friction of the rotating shoulder with the work-piece, while the rotating probe or pin stirs the heated material.Numerous studies have demonstrated that severe plastic deformation (SPD) is an effective method of producing ultrafine-grained material. There are many well established SPD techniques for grain refinement like equal-channel angular pressing high-pressure torsion multi-directional forging accumulative roll-bonding. The microstructure evolution during FSP is unique with dynamically re-crystallized microstructure possessing a large number of high angle grains. Further, most SPD techniques modify bulk properties. In contrast, SPD by FSP involves only surface modification while the bulk material structure and properties are retained. The heated material softens and flows around the rotating pin. It then fills the cavity at the rear of the tool. The material that flows around the tool is subjected to severe plastic deformation and thermal exposure, which leads to a significant refinement of microstructure in the processed zone.



II. TOOLS USED FOR FRICTION STIR PROCESSING

The friction stir processing a rotating tool is used with a pin and a shoulder to a single piece of materials to make specific property enhancement, such as improving the material's toughness or flexibility in a specific area in the micro-structure of the material via fine grain of a second material with properties that improve the first.Friction between the tool and work piece results in localized heating that softens and plasticizes the work piece. A volume of processed materials is produced by movement of materials from the front of the pin to the back of the pin. During this process the materials undergoes intense plastic deformations and this results in significant grain refinement.Friction stir processing changes physical properties without changing physical state which helps engineers create things such as High-Stream-Rate-super plasticity. The grain refinement occurs on the base material improving properties of the first materials while mixing with the second materials. This allows for a variety of materials to be alternated changed for things that may be require other difficult to acquire conditions. The process to weld two pieces of different materials together without heating, melting or having to change the material's in physical state.The tool has a crucial part to creation of the final product. The two consists of two main functions are:

- Localized heating
- Material flow

The tool at its simplest form consists of a shoulder a small cylinder with a diameter of 50 mm and a pin a small threaded cylinder similarly to a drill. The tool itself has been modified to reduced displaced volume of the metals as they merged. Recently two new pin geometries have arisen:

- Flared-Trifoliate-introducing flutes(large carving vertically on the pin)
- A-Skew-the pin axis being including to the axis to the spindle

III. PRO CESS PARAMETER

The tool geometry, welding parameters, joint designs are the signification parameters which significantly affect on the material how pattern and temperature distribution, thereby influencingthe micro structural evolution of material.A tapered cylindrical column tool without threads will significantly affects the mechanical properties of the joint sathigherrotational speed.Therefore, the rotation speed should be decreased (600 rpm) so that plastic deformation of the material could be transported from the front to the back of the tool effectively. High stress intensity can be developed at the pin shoulder corner, when the transverse speed and axial load increase. As the tool pins are heat treated to HRC 50, the tools are comparatively harder and brittle, resulting in the fracture of the tool pin. The axial load of 8.240 KN has been reported to be the optimal value for some of the aluminum.

IV. CONCLUSION

The Al-B_4C composites were produced by stir cast route with different particle size (Viz 37µ, 44µ, 63µ, 105µ, 250µ) of reinforcement and the microstructure, mechanical properties are evaluated. From the study, the following conclusions are derived.

- Production of Al-B_4C composites was completed successfully.
- The Optical micrographic study and XRD analysis revealed the presence of B_4C particles in the composite with homogeneous dispersion.
- The micro vicker's hardness of AMCs was found to be maximum for the particle size of 250µ and found maximum for 12 wt% in case of varying wt% of the reinforcement of 105µsize.
- The tensile strength of AMCs was found to be maximum for the particle size of 105µ and found maximum for 8 wt% in case of varying wt% of the reinforcement of 105µsize.