Effect Of Tic &Tungsten Nano Particles On Microstructure And Tensile Properties Of 6061T6 Al Alloy Surface Nano Composites Via Friction Stir Processing

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Abstract:
To fabricate the required material, we choose friction stir processing (FSP). Friction stir processing (FSP) is the method we use to create the necessary material. Based on the concepts of friction stir welding, friction stir processing (FSP) is used to alter the microstructure and characteristics of surfaces. It is utilised to create surfaces. Aluminium alloys, which include mixes using magnesium and silicon as the main alloying materials, include the composite kind of 6061 aluminium. It can be produced quickly, heat-treated, welded, and has good corrosion resistance. Nanoparticles are added to the aluminium 6061 surface to alter it. Nanoparticles like tungsten (W) and titanium carbide (TiC) are utilised to alter the surface of aluminium 6061. The mechanical properties of the manufactured surface composites are identified through examination. The mechanical properties which investigate the Tensile, Impact, Optical , Metallography, Microhardness. The analysis of composites and its mechanical behavior provide the possibility of achieving the improvements in properties of nano composites.

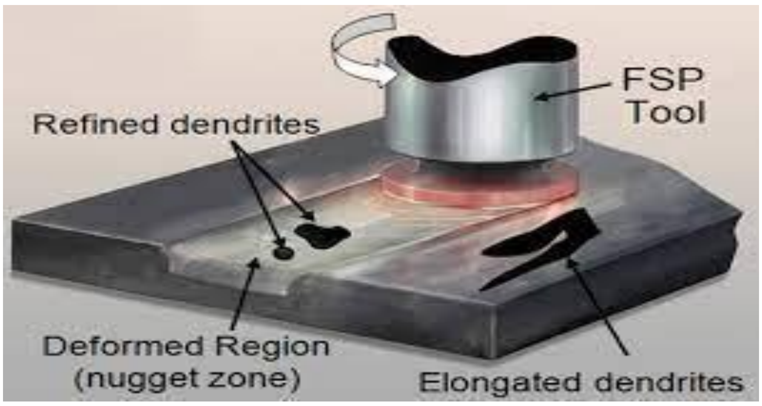
Keywords: Aluminium 6061, (TIC), (W) Nano particles, Friction stir processing.

1. INTRODUCTION :

Changing the characteristics of a metal using friction stir processing localised plastic deformation that is severe. This deformation is caused by forcing a non-consumable tool into the work piece and rotating the tool while it is inserted in a stirring action lateral pressure was applied to the workpiece. When ideally implemented, this process mixes the material without changing the phase (by melting) and creates microstructure with fine, equiaxed grains.

This homogeneous grain structure, separated by high-angle boundaries, allows some aluminium alloys to super plastic properties. Friction stir processing also enhances the tensile strength and fatigue strength of the metal. In tests with actively cooled magnesium-alloy work pieces, the micro hardness was almost tripled in the area of the friction stir processed seam.

Intense plastic deformation of the material at a high temperature occurs during the FSW process, producing fine and equiaxed recrystallized grains. Friction stir welds produce good mechanical properties due to their fine microstructure.



Welding Parameters :

Tool Geometry	Traverse speed in Rpm	Rotational speed in Rpm
Tapered Threaded Cylindrical	20	900
	30	1150
	40	1400

2. EXPERIMENTATION:

The experimental study relates the reinforcement of Al 6061-T6 alloy with Titanium carbide and Tungsten nano powder via friction stir welding. An Al 6061 T6 alloy plate of required dimensions is 150*200*10mm.Themillingis performed for finishing plates.

On these plates the holes are drilled with the CNC machine. The dimensions of holes are2mm depth and 2mm distance between the each hole. And the bind holes are filled with Titanium carbide and Tungsten Nano powder at an required volume percentage and the region is welded with tapered threaded cylindrical tool according to their requirement. The dimensions of tool pin height is 5mm and diameters are 6mm and 4mm.

Fig. Bind holes on Al 6o61plates (Top Bottom)

Here Non consumable tool made of H13 tool steel is used for welding. The tapered threaded cylindrical tool is considered with traverse speed i.e, 20,30,40 and rotational speed i.e, 900,1150,1400. Friction stir welding is performed on plate which is filled with the nano powders. Friction stir processing is a method of changing the properties of a metal through intense, localized plastic deformation. This deformation is produced by forcibly inserting a non consumable tool into the work piece, and revovling the tool in a stiring motion as it is pushed laterally through the work piece.

Fig. Test specimen

3. RESULTS:

TENSILE TEST

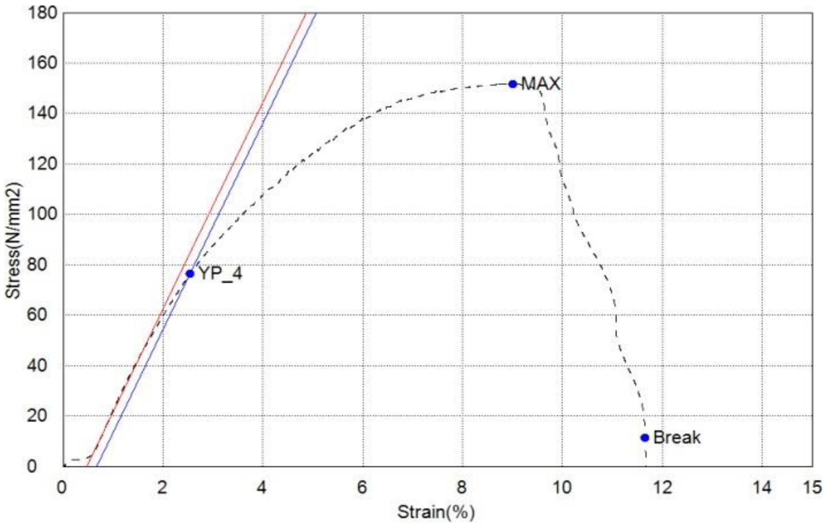
Analysis obtained:

1. YP(%YP)_Stress
2. Maximum Stress
3. Fitted Strain
4. Reduction in area
5. Break Stress

Tensile test Observations of Sample 1

Name	YP(%YP)_Stress	Max_ Stress	Fitted_ Strain	Reduc.
Parameters	0.2%	Calc. at Entire Areas		
Unit	N/mm2	N/mm2	%	%
Al-1	76.5312	151.702	7.30000	15.6721

Name	Break_ Stress
Parameters	Sensitivity:10
Unit	N/mm2
Al-1	11.3125

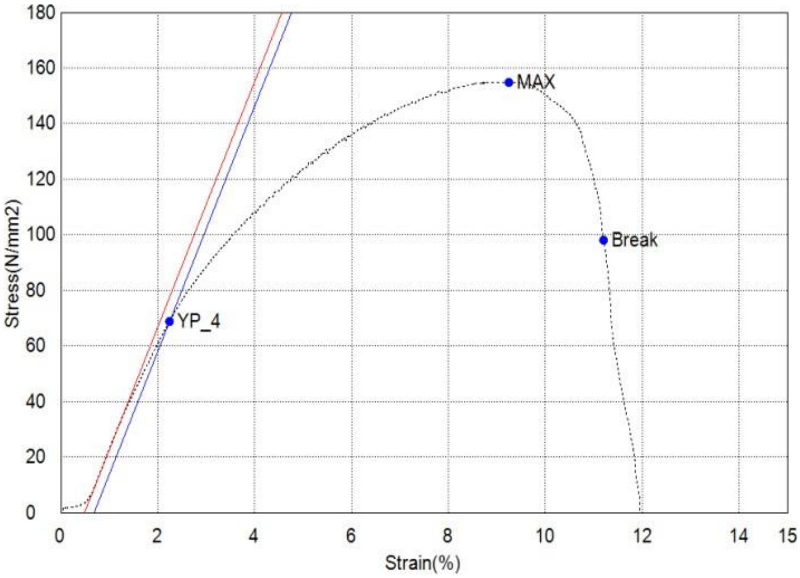


Stress vs strain sample 1

Tensile test Observations of Sample 2

Name	YP(%YP)_Stress	Max_ Stress	Fitted_ Strain	Reduc.
Parameters	0.2%	Calc. at Entire Areas		
Unit	N/mm2	N/mm2	%	%
Al-2	68.6280	154.746	10.7200	19.4903

Name	Break_Stress
Parameters	Sensitivity:10
Unit	N/mm2
Al-2	98.1657

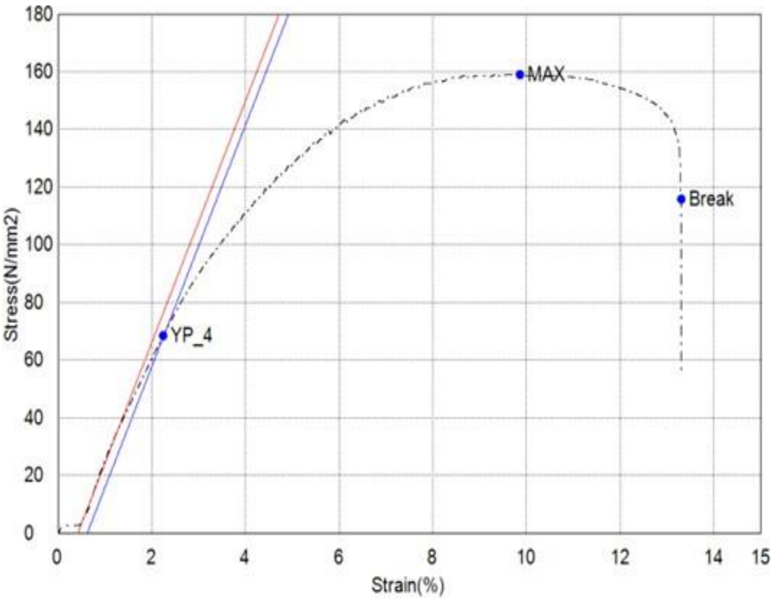


Stress vs strain sample 2

Tensile test Observations of Sample 3

Name	YP(%YP)_Stress	Max_ Stress	Fitted_ Strain	Reduc.
Parameters	0.2%	Calc. at Entire Areas		
Unit	N/mm2	N/mm2	%	%
Al-3	68.4686	159.078	10.8800	29.3785

Name	Break_ Stress
Parameters	Sensitivity:10
Unit	N/mm2
Al-3	115.595

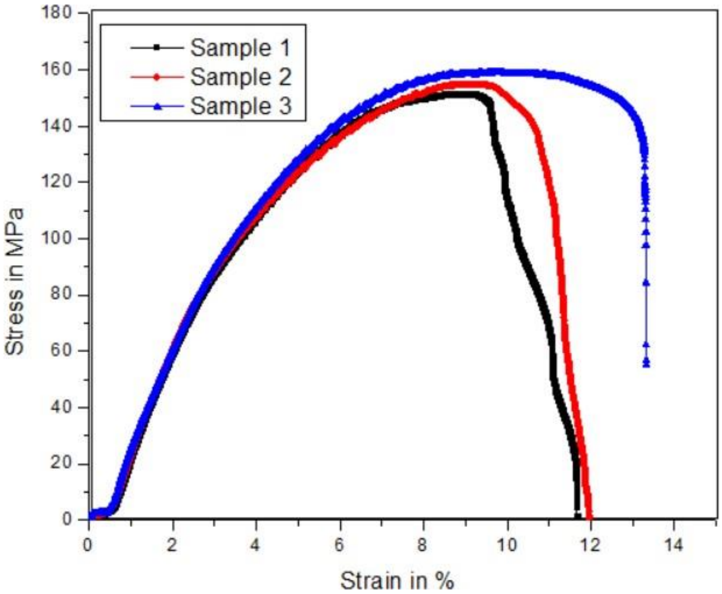


Stress vs strain

ComparisonanalysisofAl6061samples

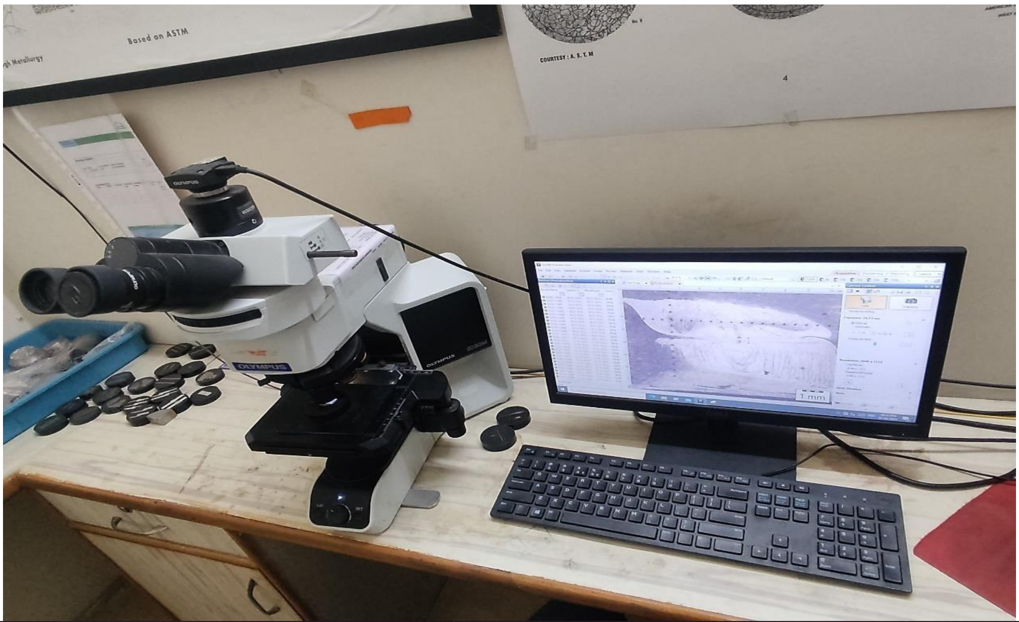
Sample Id	UTSIN MPa	YS in MPa	% Elongation	%RA	Broken Zone
FSW/TTC/20/900	151	76	7.3	15	Weld Zone
FSW/TTC/30/1150	154	68	10	19	Weld Zone
FSW/TTC/40/1400	159	68	10	29	Weld Zone

Origin Graphical Representation



Graph: Comparison of 3samples StressVsStrain

METALLOGRAPHY OBSERVATION



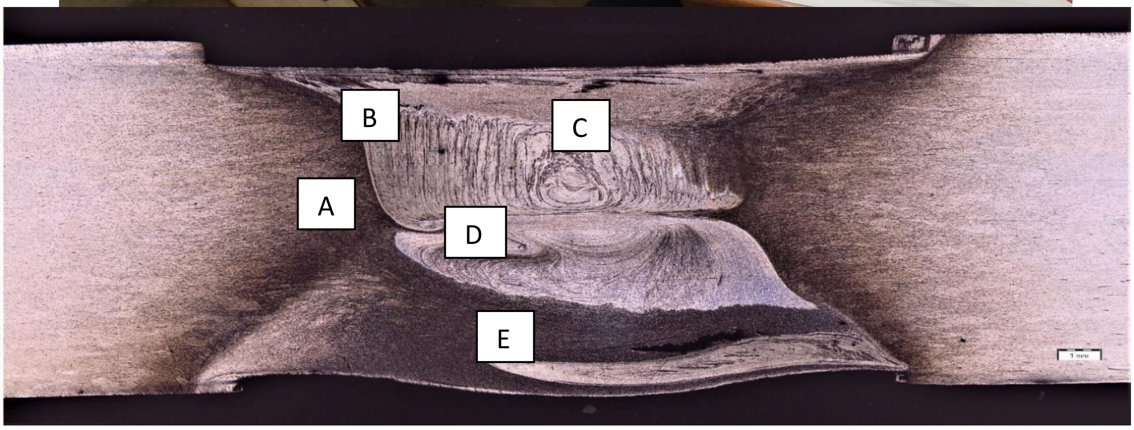


Fig Macro Structure of FSW double side weldof sample3 @ 12.5

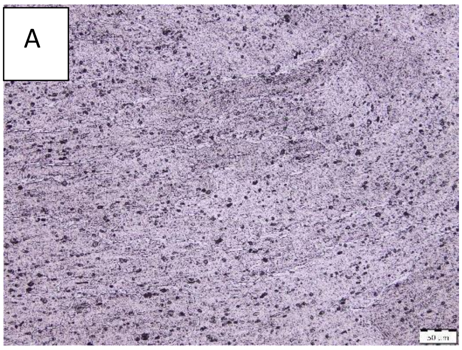


Fig: Micro structure eat TMAZ

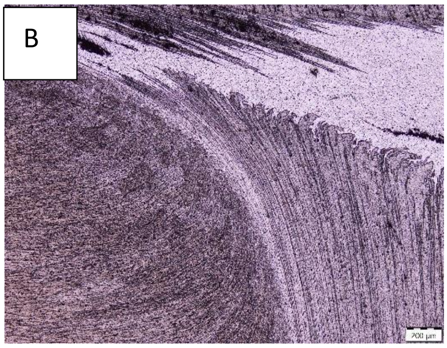
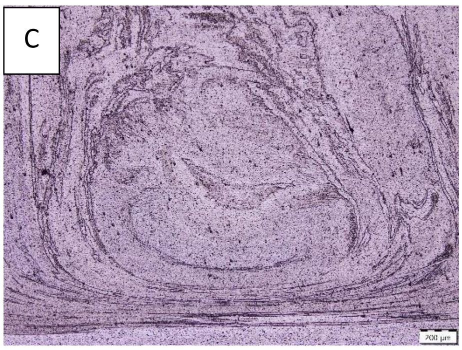


Fig : Microstructure at Interface(Thermo-mechanically affected Zone)



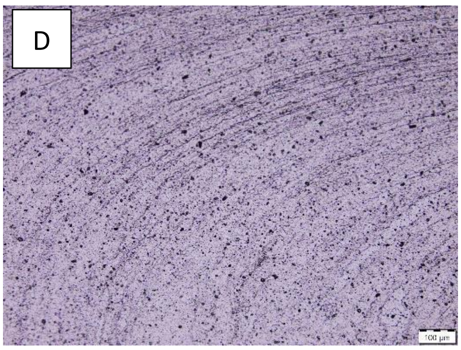


Fig: Microstructure at Nugget Zone

Fig: Microstructure at Nugget Zone(Bottom)

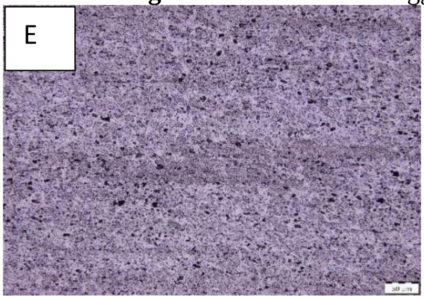


Fig: Microstructure at Nugget Zone(Bottom)

MICROHARDNESS SURVEY

Fig: Testing of hardness of sample 3

Fig : Different indentations on sample 3

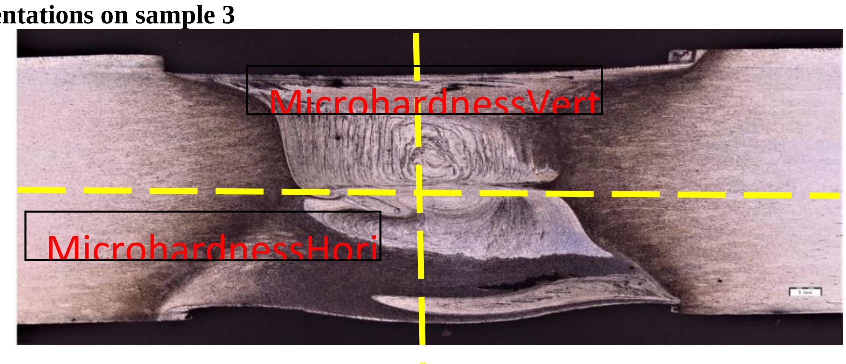
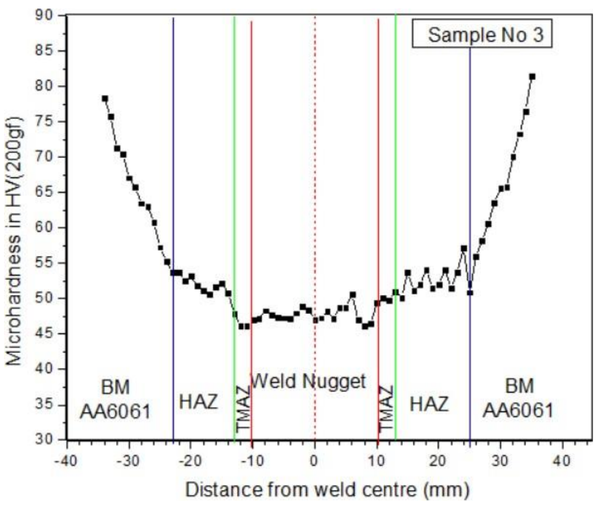
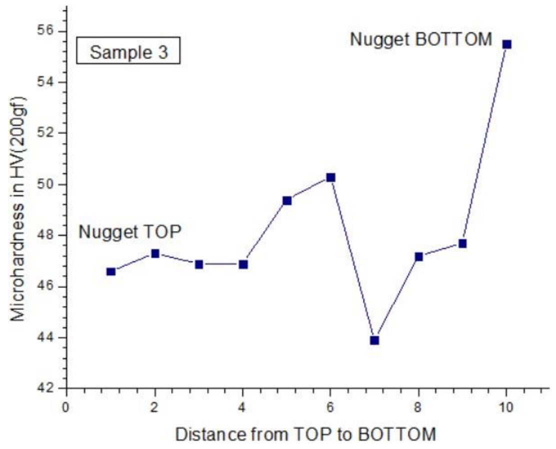


Fig : Different indentations on sample 3



Graph : Hardness profile Horizontal



Graph : Hardness profile Vertical

IMPACT CHARPY TESTc

Fig :Impact Charpy testing

Sample ID	Charpy Impact values in joules
FSW/TTC/20/900	**46Joules**
FSW/TTC/30/1150	**44Joules**
FSW/TTC/40/1400	**46Joules**

CONCLUSION

In this investigation an attempt was made to understand the effect of tool profile such as Taper Threaded with different Traverse speed 20,30,40 and Rotational speed 900,1150,1400 and different Nano powder i.e, Tic, W. The following calculations are drawn from the analysis.

Tensile test: Considering sample 3 as the best result compare to sample 1 and 2
Sample 3 values
UTS 159 in MPa
Ys 68 im Mpa
Elongation 10%
Reduction area 29%
Broken zone%

Metallography Report: Considering the sample 3 as the best sample
Findings with the sample 3 are
Microstructure at TMAZ,
Microstructure at Interface,
Microstructure at Nugget zone,
Microstructure at Nugget zone (Bottom),
Microstructure at Nugget zone(Bottom),

Microhardness Survey: Considering the sample 3
The microhardness is maximum at the Base Material of sample 3 while testing through Horizontal profile.
The microhardness is maximum at the Nugget Bottom of sample 3 while testing through Vertical profile.

Charpy Impact test:
Considering the sample 3
Sample 3 Charpy impact test as the maximum value of 46 J

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