PRACTICAL AND ANALYTICAL VALIDATION OF SPECIAL MATERIALS WITH NANO STRUCTURAL APPROACH

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Abstract:

In the present research an approach is carried out on special alloy materials like AL6061, TIB_2, and NANO FLY ASH used in aero space applications with Nano structural approach. The properties of the each material is studied and enhanced and is divided into different mixing percentages for process enhancement. Initially the super alloys are mixed with different percentages and the test samples are prepared. Approaches such SEM, FEM is analyzed for finding the better obstacle of the materials and samples prepared from the super alloys. Micro structural enhancement is done for all the samples prepared to find the better approach of the sample in the process during some tensile load conditions. Finally the validation is given for the best tested sample having good stability in both experimental and analytical approach under different loading conditions.

Keywords: SEM, FEM, tensile

Introduction:

Nano-structured materials often possess special properties that materials with identical compositions but ordinary grain size do not have. This paper reports our work on the surface nano-crystallisation and nano-structured alloy and composite coatings. A number of processing methods including magnetron sputtering, thermal spray and pulse electro-spark deposition have been used to produce surface nano-crystalline structure. The compositions and microstructures can be well controlled by using different targets or electrodes, nano-structured composites and adjusting processing parameters. Surface nano-structured coatings can provide special chemical, mechanical and electronic properties such as high temperature corrosion and corrosive wear resistance. It has potential applications such as turbine blades, engine parts for petrochemical, aerospace and electronic device industries Aluminium matrix composites with MgO reinforcements give superior mechanical & physical properties. Their applications in several demanding fields like automobile, aerospace, defense, sports, electronics, bio-medical and other industrial purposes are becoming essential for the last several decades because of their improved physical and mechanical properties such as light weight, high strength, good corrosion resistance, malleability, etc., This paper reviews the comparative mechanical properties of Al 6061 Aluminium Alloy with Al 6061 - Magnesium Oxide (MgO) Composite of different wt. %. Al 6061 aluminium alloy is reinforced with 1.0, 1.5, 2.0, 2.5 weight percentage of Magnesium Oxide (MgO) particles through powder metallurgy method with optimum sintering temperature. The composites were then characterized by scanning electron microscopy (SEM)). The tribological behavior is investigated using pin-on-disc equipment and mechanical properties (Micro hardness, Compressive strength) were analyzed at varying weight percentage ratios. Introduction of MgO particles to the Al matrix caused increasing of wear resistance, mechanical strength and it doubles the hardness.

2.0 Acoustical performance testing

The impedance tube method for sound absorbing testing based on transfer function method ISO 10534-2 standard was used. The frequency dependencies of the sound absorption co-efficient were experimentally measured using a two-microphone impedance tube (BK 4206) in combination with three-channel signal PULSE multi-analyzer (BK 3560-B-030) and power amplifier (BK 2706) in the frequency range of 150e6400 Hz. The normal incidence sound wave absorption of the tested loose powder samples of defined layer thickness (ranging from 2.5 to100 mm) was determined. All experiments were performed under ambient laboratory conditions of 40% relative humidity and at 22ºc.

Fabricated Samples For Different Tests:

Tensile test sample R1 with mix of Al6061+Flyash

Tensile test sample R2 with mix of Al6061+TiB_2

Tensile test sample R3 with mix of Al6061+TiB_2+F.A

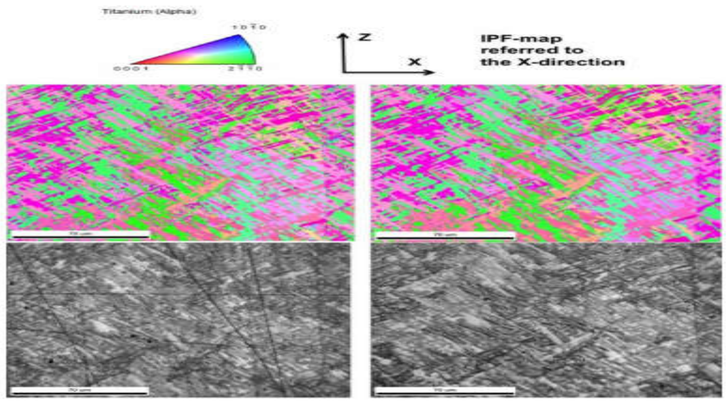
Fabricated test samples R1, R2, R3 for hardness testing

Fabricated test samples R1, R2, R3 for SEM approach

Fabricated test samples R1, R2, R3 for OM approach

Fabricated test samples R1, R2, R3 for Radiography approach

Hydrocarbon deposition was considred as a neglible factor for reducing the overall quality of the parameters since the hydrocarbon layer was removed by the ion milling sequence. The deformation after the scalpel was to large to be removed by the ion milling. The effect of the ion milling sequence on a fine-grained region of the microstructure can be seen in Figure.



Left: Not ion-milled. Right: ion-milled. Magnification 400X, step size 0.5µm. Ip=.83nA.

The quality parameters of the EBSD-map can be found in Table. Left images below is without ion milling, right image was ion milled for 30min. The effect of the ion mill could be seen as a removal of the grinding-stripes in the IQ-map. This also explains the improvement in the IQ-value in the table. However, no effect could be observed in the IPF-map. Investigated specimen was from block T200.

Machinability Observations

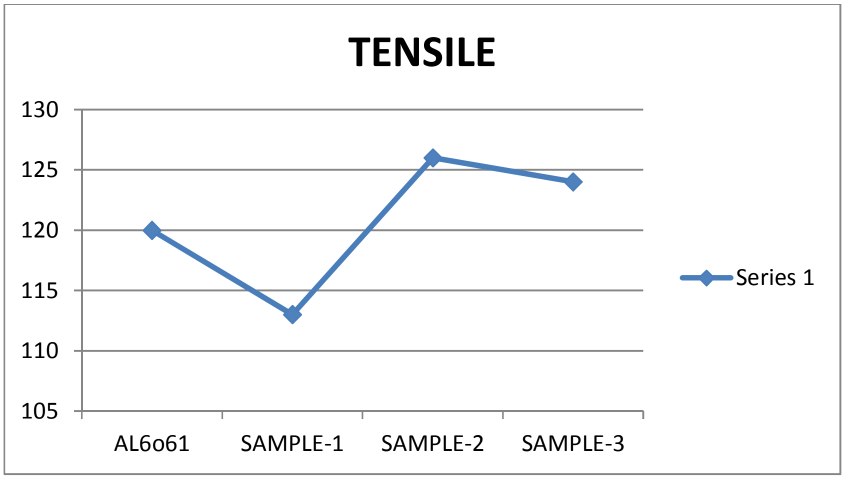
By checking the machining samples it is observed that machining done very smoothly and there is no blow holes find in the casting samples. By checking threaded portion we can find the bonding ability of atoms while casting is done becuse of constant stirrer speed.

TENSILE TEST

S.No	Sample Designations	U.T.S (Mpa)
1	ALSiC	120
2	Sample 1	113

3	Sample 2	126
4	Sample 3	124

Above table is tensile test report be half of our testing specimens which are varying just a small difference of 3-4 MPa for different samples.



The above graph shows the variations of different samples subjected to tensile test.

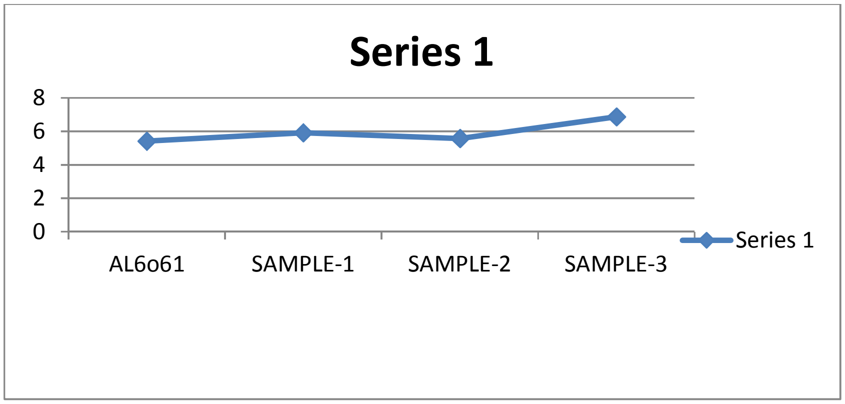
HARDNESS TEST (BHN)

Sl.No	Sample Designations	HARDNESS (BHN)	U.T.S (M.Pa)	Elongation (%)
1	ALSIC	85.3	162.2	5.42
2	Sample 1	89	170	5.92
3	Sample 2	92	164	5.57
4	Sample 3	86	158	6.87

Above table is hardness test report be half of our testing examples where the estimations of Hardness, U.T.S and rate prolongation with a little contrast of fluctuation.

% Elongation

The above graph shows the variations of different samples subjected to Hardness Test.



The above graph shows the variations of different samples subjected to elongation percentage.

THERMAL EXPANSION

S.No	Sample Designations	Temperatures 30-100ºC	Temperatures 30-150 ºC	Temperatures 30-200 ºC
1	ALSiC			
2	Sample 1	8.00 σ=0.26/ ºC	8.37 σ=0.26/ ºC	8.75 σ=0.27/ ºC
3	Sample 2	9.77 σ=0.26/ ºC	10.16 σ=0.26/ ºC	10.56 σ=0.25/ ºC
4	Sample 3	10.9 σ=0.25/ ºC	11.20 σ=0.25/ ºC	11.7σ=0.25/ ºC

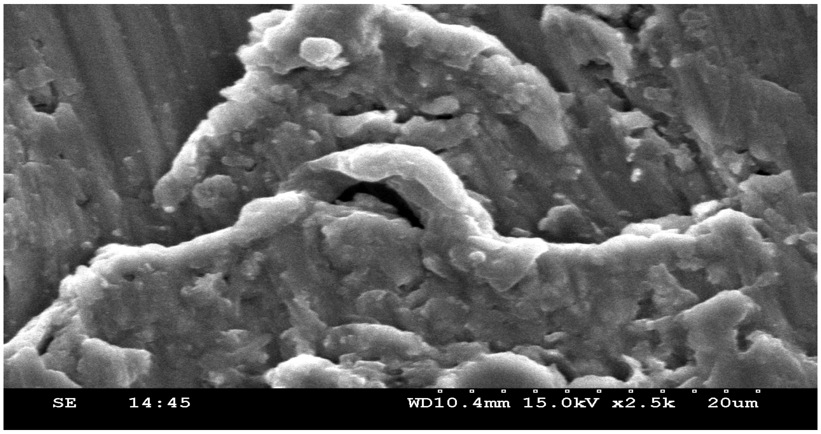
Above table is Thermal Expansion be half of our testing specimens which are showing variance of different temperatures for different samples.

Electrical Resistance

Sl.No	Sample Designations	Electrical resistance(Ω/cm)
1	ALSiC	3.99 e^{-006} ohm-cm 3.90 E^{-06}
2	Sample 1	3.99 e^{-006} ohm-cm 3.94 E^{-06}
3	Sample 2	3.99 e^{-006} ohm-cm 3.99 E^{-06}
4	Sample 3	3.99 e^{-006} ohm-cm 3.96 E^{-06}

SEM IMAGES at S-3000N

Sample-1 (Liquid state with magnification=2500)



DataSize=1280x960

Magnification=2500

AcceleratingVoltage=15000 Volt

EmissionCurrent=13000 nA

WorkingDistance=10400 um

SignalName=SE

SubMagnification=2500

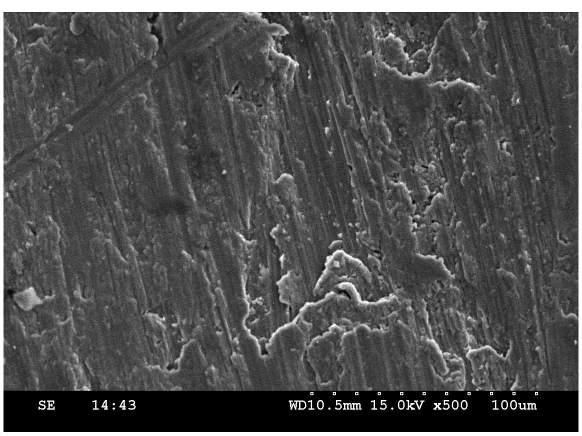
SubSignalName=SE

PhotoSize=1000

Vacuum=High

The above figure demonstrates the sample 1 of amplified SEM & OM material with amplification of 2500 meters which is in liquid state.

Sample – 1 (Molten state with magnification=500)



DataSize=1280x960

Magnification=500

AcceleratingVoltage=15000 Volt

EmissionCurrent=13000 nA

WorkingDistance=10500 um

SignalName=SE

SubMagnification=500

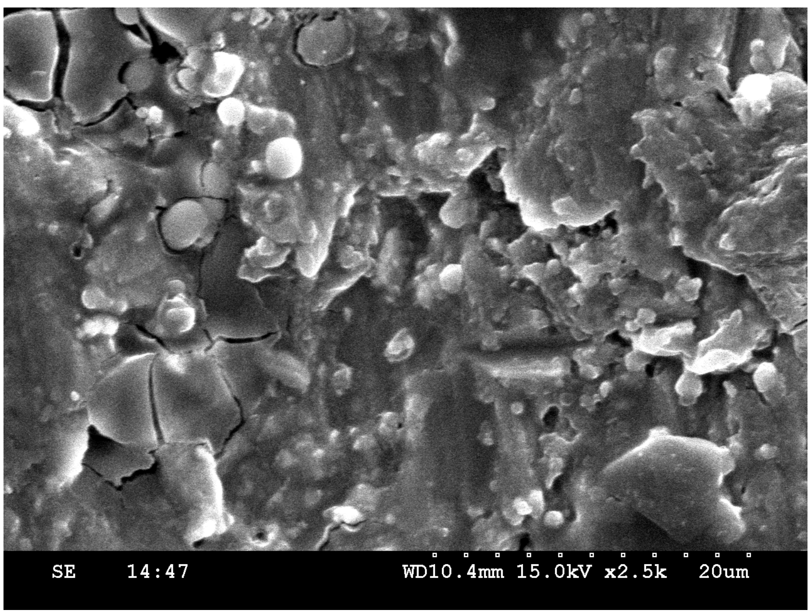
SubSignalName=SE

PhotoSize=1000

Vacuum=High

The above figure show the sample-1 of magnified SEM & OM material with magnification of 500 meters which is in molten state.

Sample-2 (Liquid state with magnification=2500)



DataSize=1280x960

Magnification=2500

AcceleratingVoltage=15000 Volt

EmissionCurrent=14000 nA

WorkingDistance=10400 um

SignalName=SE

SubMagnification=2500

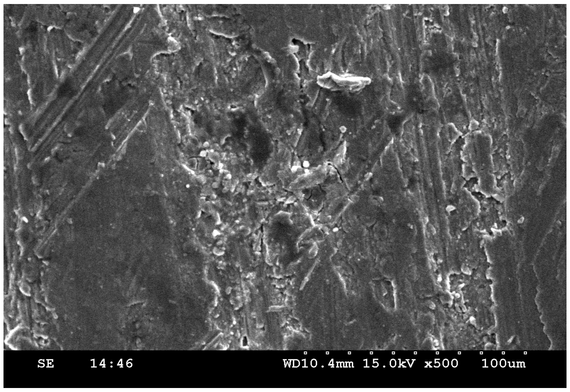
SubSignalName=SE

PhotoSize=1000

Vacuum=High

The above figure show the sample-2 of magnified SEM and OM material with magnification of 2500 meters which is in liquid state.

Sample - 2 (Molten state with magnification=500)



Conclusion:

An experiemental research is conducted by taking special alloys and fabricated as test samples. The samples like Al6061 mixed with TiB_2 and 10% flyash is taken and is made into three samples

- Al6061+10% Flyash =R1
- Al6061+TiB_2 =R2
- Al6061+TiB_2+10% Flyash =R3

Various testing's are conducted on these samples R1, R2, R3 like tensile test, hardness test, % of elongation, SEM approach, OM approach, radiography is conducted for finding best mixed alloy sample. Finally it is observed that the sample R2 that is Al6061 mixed with TiB_2 is obtaining better performance in all the cases of tensile, hardness and other test conditions.

References:

1. Reynolds DW, Facchine KL, Mullaney JF, Alsante KM, Hatajik TD, Motto MG, "Available guidance and best practices for conducting forced degradation studies" Pharmaceutical Technology, 2002; 26(2): 48-54.
2. Abhijit Dey, Krishna Murari Pandey (2016), "Characterization of Fly Ash and Its Reinforcement Effect on Metal Matrix Composites: A Review", Rev.Adv. Mater. Sci., ISSN: 1605-8127, Volume No: 44, Issue No: 1, PP: 168-181
3. Farhad Gharavi, Khamirul Amin Matoria, Robiah Yunus, Norinsan Kamil Othman (2014), "Corrosion Behavior of Friction Stir Welded Lap Joints of AA6061-T6 Aluminum Alloy", Materials Research, ISSN: 1980-5373, Volume No: 17, Issue No: 3, PP: 672-681
4. Goud, A.S., Chennakesava Reddy, A (2011), "Interface Failure Analysis of TiB2 Reinforced Aluminum Alloy Matrix Composites", 3rd International Conference on

Modern Materials and Manufacturing, ISSN: 1757-899X, Volume No: 1, Issue No: 2, PP: 325-328

5. Hongwei Wu, Yi Li (2012), “Ash Cenosphere from Solid Fuels Combustion. Part 1: An Investigation into Its Formation Mechanism Using Pyrite as a Model Fuel”, Energy and Fuels, ISSN: 0887-0624, Volume No: 26, Issue No: 1, PP: 130–137
6. Pradeep Kumar, G.S., R. Keshavamurthy, Prachi Kumari, Chirag Dubey (2016), “Corrosion behaviour of TiB2 reinforced aluminium based in situ metal matrix composites”, Perspectives in Science, ISSN: 2213-0209, Volume No: 8, Issue No: 2, PP: 172-175
7. Yogeshwaran, S., Prabhu, R., Natrayanc R.Murugan, L (2015), “Mechanical Properties Of Leaf Ashes Reinforced Aluminum Alloy Metal Matrix Composites”, International Journal of Applied Engineering Research, ISSN: 0973-4562, Volume No: 10, Issue No: 13, PP: 11048-11052