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Yulius Eka Agung Seputra
Vocational Program, Applied Science, Universitas Indoensia, yulius.eka@gmail.com

Chanra J. Soegijono. B
Material Science, Department of Physic, Universitas Indonesia,, Johannes.Chandra@yahoo.com.sg

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Yulius Eka Agung Seputra[1] and Chanra J. Soegijono. B [2]

Vocational Program, Applied Science, Universitas Indoensia, yulius.eka@gmail.com[1]

Material Science, Department of Physic, Universitas Indonesia, Johannes.Chandra@yahoo.com.sg[2]

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Abstract

Aluminum Matrix Composites (AMC) reinforced montmorillonite (MMT) was performed using cationic surfactant , Artificial Aging and stir casting method. The content of MMT as a filler is 3%wt. Characterization were performed using Xray Difractometer, ultrasonic testing, SEM, and Hardness Vickers. The results show increase in crystallographic parameter, decrease in density, shiffting in XRD pattern and increase in hardness.

Keywords: *metal, composite, matrix, aluminum, AMC, MMC, organoclay, heat treatment MMT, artificial aging,stir casting, automotive*

Abstrak

Perlakuan Panas Enkapan Penguat Aluminium Matriks Komposit (AMC) untuk Aplikasi Otomotif. Aluminium Matrix Composites (AMC) diperkuat montmorillonite (MMT) dilakukan dengan menggunakan surfaktan kationik, metode Penuaan Buatan dan Pengadukan. Isi MMT sebagai filler adalah 3% wt. Karakterisasi dilakukan dengan menggunakan Xray Difractometer, pengujian ultrasonik, SEM, dan Hardness Vickers. Hasilnya menunjukkan peningkatan parameter kristalografi, penurunan kerapatan, pergeseran pola XRD dan peningkatan kekerasan.

Kata Kunci: logam, komposit, matriks, aluminium, AMC, MMC, organoclay, perlakuan panas MMT, penuaan buatan, pengecoran aduk, otomotif

INTRODUCTION

The use of composites in automotive applications increased in decades lately. Modifications composite with a metal alloy ,ceramic, polymers may improve the mechanical properties of the composite can be used instead of steel as the material of automotive applications (B.N.Sarada et al, 2015).

Improved mechanical properties of composites in many research using aluminum as a matrix known as the Aluminum Matrix Composites (AMC) and is reinforced with a filler Bamboo Leaf Slag (BLA) with composition of 0,2,3,4 % Wt (Alaneme K.K., 2013) or increasing lack purity aluminum matrix with another metal alloy (Al-Mg-Si) with a composition of 10 wt% (M. Gupta, M.K. Surappa, 1995) and by using ceramic used to 10 wt% SiC affecting the mechanical properties of the composite ie hardness, elasticity, strain (Chennakesava Reddy A and Sundararajan S, 2005).

Improved AMC to provide reinforcement properties of metal alloys (metal alloy) on a matrix of aluminum will increase the tensile properties of composite (Chennakesava Reddy A and Sundararajan S, 2005).

The addition of a ceramic variations such as TiC, TiC, TiB2 and B4C as filler (filler) on AMC improve material hardness (C. Gonzalez, A et al, 2005). AMC reinforced with polymer will increase strength and stiffness in its matrix (Kashish Goyal and Karthikeyan Marwaha, 2016). Besides heat treatment varied particle size reinvorcement AMC will improve the mechanical properties (mechanical properties) (Sanjay Soni, ajay Pandey, 2014).

In this research aims to improve the mechanical properties of AMC by heat treatment Stir Casting and filler montmorillonite (MMT) organoclay which has a small particle size to the nanoscale (5-10 nano) with the composition of 3wt%, and will increase the mechanical properties the most optimal from a composite that will be used for automotive applications.

MATERIALS AND METHODS

Matrix

Aluminium alloy (6061) is selected as matrix alloys for synthesis of AMC. The chemical compositions of aluminium alloy was analyzed using glow discharge spectrometer (Model: GD Profiler 2).

Table 1. Properties of Matrix

Property	Unit	Al (6061)
Density	g/cm^3	2,7
Melting Point	^{o}C	660
Coefficient of thermal Expansion	µm/m°C	23,4
Thermal Conductivity	W/mK	166
Young Modulus	GPa	70

Reinforcement

Modified Na-montmorillonite clay (Na-MMT) with Cation Exchange Capacity, CEC 87.53 meq/100g was supplied by Zhejiang FCC New Material Technology Company Limited .

Composite Production

Production of composites made with stir casting process. Stirring were carried out with a rotational speed of 400 rpm, at a temperature of 750 oC. Pouring molten metal into the mold were done with temperature variation cast: 600, 700, 725 and 750 oC. When the matrix was in the completely liquid condition, blending were begun following 2 minutes. Stirrer rpm is steadily expanded from 0 to 400 RPM with the assistance of velocity controller. Temperature of the warmer was set to 600°C which was underneath the softening temperature of the network. A uniform semisolid phase of the liquid lattice was accomplished by blending it at 700 °C.

Heat Treatment

The Sample Al-Organoclay were heat treated in a furnace to look at the properties in matured and as cast condition. There were three phases required in the heat treatment. The sample were heated to a temperature of 490 ± 5 oC for 8 hours until the alloy solute components are totally broken down in the Al solid solution. Extinguishing: the arrangement treated examples were quickly cooled into oil to keep the precipitation of the solute components and to acquire a super soaked strong arrangement and Artificial aging: To enhance the quality and hardness of the material were heated 240 oC for 6 hours each and afterward permitted to cool in the still air [8].

Characterization

The samples in as cast and heat treated condition were then tried for different tests. X-ray diffractometer was used to characterize the crystallography parameter. Measurement of Young modulus of the composite were carried out by ultrasonic testing. Scanning Electron Microscope (JEOL make, Model JSM 6510) was used to observed morphology

RESULT AND DISCUSSION

Chemical composition

Tabel 1 show the composition of the matrix, Aluminium alloy 6061.

Table 1. Chemical composition of Aluminium (6061) alloy

Material	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti
Al 6061	0.8	0.7	0.4	0.15	1.2	0.35	0.25	0.15

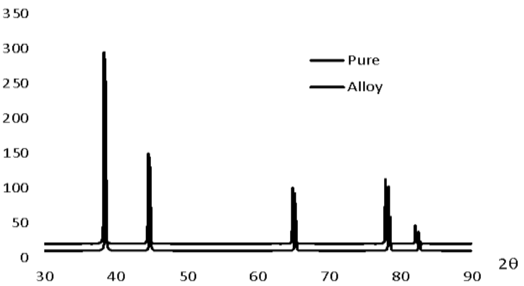

Figure 1. XRD pattern of pure and Allumunium Alloy

\Tabel 2. Crystallography parameter of Al and Al alloy+MMT

Materials	a (A)	Space group	ρ (gr/cm3)
Al	4.046	F m -3 m	2.70
Al 6061+MMT	4.205	F m -3 m	2.33

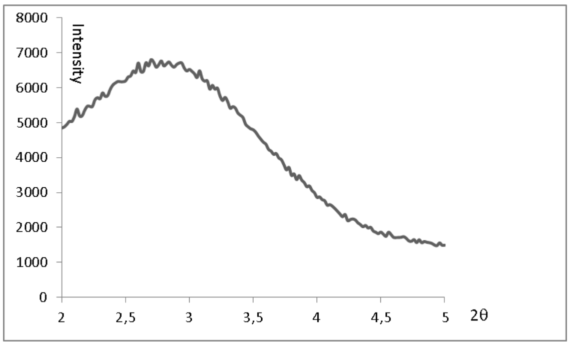

Figure 2. XRD pattern of Na-MMT after intercallation

Tabel 3. Young Modulus and Hardness Al and Al alloy+MMT

Materials	Y (Gpa)	Hardness Vickers
Al	70	150
Al 6061+MMT	75	160

Figure 3. Morphology of Al+MMT

Figure 1, show XRD pattern of Aluminium and Alluminium alloy+MMT used in this research. XRD pattern of Alumunium alloy show shifting of the patterns to the right. It means that the planes distance of the crystall decrease lead to the decrease in density. Table 2 show crystallography paraameter of Al and Al alloy 6061

Figure 2 show the shiffting of peak Na-MMT to the left, indicate the pillarized Na-MMT. Tabel 3 show the young modulus and hardness vickers of pure Al and Al alloy+MMT. Figure 3 show morphology of Al+MMT.

CONCLUSION

Addition of 3%wt MMT in Aluminium decrease density and increase hardness. It seem that this composite (Al alloy+MMT) could be a challence for new application in automotive materials.

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REFERENCE

Alaneme K.K., Ademilua B.O, Bodunrin M.O., Tribology in Industry, 35 No. 1 (2013) 25-35.

B.N.Sarada, P.L.Srinivasa Murthy, G.Ugrasen, Hardness and wear characteristics of Hybrid Aluminium Metal Matrix Composites produced by stir casting techniqueHardness and wear characteristics of Hybrid Aluminium Metal Matrix Composites produced by stir casting technique, 4th International Conference on Materials Processing and Characterization Proceedings 2 (2015) 2878 – 2885.

Chennakesava Reddy A and Sundararajan S ," Influences of ageing, inclusions and voids on the ductile fracture mechanism of commercial Al-alloys", J. Bull. Material Sci. 28(1), 101-105,2005

C. Gonzalez, A. Martin, J.Llorca, M.A. Garrido, M.T. Gomez, A. Rico and J.Rodriguez, "Numerical analysis of pin on disc tests on Al-Li/SiC composites", International Journal of Wear, Vol. 259, pp. 609–612, 2005.

Kashish Goyal and Karthikeyan Marwaha, Processing and Properties of Aluminium Matrix Composites: A Short Review , European Journal of Advances in Engineering and Technology, 2016, 3(8): 54-59

M. Gupta, M.K. Surappa, Processing-microstructure-mechanical properties of Al based metal matrix composites synthesized using casting route Key Eng. Mater. (Switzerland), 104–107 (1995), pp. 259–274.

Muhammad Hayat Jokhio, Muhammad Ibrahim Panhwar, And Mukhtiar Ali Unar , "Manufacturing of aluminium composite material using stir casting process", Mehran University Research Journal Of Engineering & Technology, Volume 30, No. 1, [Issn 0254-7821] ,2011

Sanjay Soni, ajay Pandey, Effect of heat treatment on mechanical properties structural response of Al-Si Composite, International Journal of Advanced Mechanical Engineering, pp 767-782,2014.