Fabrication and Mechanical Characterization of Aluminum Oxide and Polyimide based Composite metal

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Abstract – In this paper examines several aspects of the composite testing, including: prepared the mixture of aluminum oxide is base metal and other is polyimide material composite. The focus of this paper in determines the mechanical properties of composite. Aluminum oxide and polyimide material of the intensive experimental analysis of composite. This is composite used to aircraft components and air vehicles' components. Tensile test, conductivity test, bending test, hardness test, and time, temperature, pressure etc. this composite is main prepuce of less weight and less density. The practical test specimens were prepared by the set-up for vacuum bag molding technique. This research paper in determine the mechanical properties of the composite metal aluminum oxide and polyimide nylon based (non-metal). The experimental analysis of these composite are focused on the mechanical properties. The practical test specimens were developed by hand layup technique.

Key Words: Bending test, Strength test, Stiffness test, Temperature, mass etc.

INTRODUCTION

In the literature, it is possible to find many contributions about the composite materials (E .g aluminum oxide and polyimide nylon based non-metal), composite metal laminate. Considering applications experimental tests and different approaches for, modeling. To identify and determine the mechanical properties of composites materials, standards' and considered to experimental methods developed for solid homogeneous materials can be applied. Same traditional methods, like tensile test measurements from tensile gages, lead to the high variation in the obtain results. This can be explained through the weakening of the solid with the presence of the voids inside. That fact, when the material under investigation is a composite structure like, aluminum oxide and polyimide nylon based (non- metal).The identification of the mechanical properties of this, "composites material" longer straight forward. In the addition, the fiber forms are actually a micro structure with micro mechanisms of structure failure combined with response from the based metal aluminum oxide, which is polyimide. Therefore the determination of the mechanical properties and strength values of composites material requires an extra attention when analyzing the results from standard test. Regarding the challenge described above, some researchers. Decided to apply digital image correlation DIC technique in order to obtain more accuracy results. Even though digital image correlations techniques are well know those days, this paper find out the result of specific DTC technique, named applied to rigid aluminum oxide and polyimide fiber metal laminate form. In fact the fabrication and experimental analysis of aluminum oxide and polyimide nylon based (non- metal) laminate to improve the understanding of the mechanical behavior and calculation of mechanical properties for aluminum oxide and polyimide nylon based (non- metal) composite metal in under compression loading. Also, the present work brings a lot more rigid and results from the compression test for closed cell rigid composite form. For the example, experimental results are discussed in detail. Its influence on the stress strain curves and on the determination of the mechanical Showing the anisotropy of the composites form under the compression and properties. Besides the present paper discusses not only about Poisson's ratio but also about yield fronts created by the compression loading and the influence of spring – back phenomenon on hardening curves using SEM Scanning Electronic microscopic analysis. It is the composite of fiber metal laminate (FML). Such that fiber metal laminate (FML) it can be fabricated from an alternating layers of aluminum oxide layer and other is polyimide nylon based (non-metal) layer. The several variables are involved in the composition of this laminate a wide range of pure layer of aluminum oxide and pure layer of polyimide nylon based (non-metal). Combinations lamination seems to be possible. The numbers of layers, the orientation of (fibrous) layers etc. therefore (FMLs) are generated as a family of laminates. The layer made from aluminum layers in the range of 0.4 – 0.6 mm thick, and polyimide nylon based (non-metal) layers in the range of 0.27 – 0.52 mm thick. The composite metal laminate (FML) wide usage of in the aerospace application. In the research paper in composite metals on the expected growth of aircraft, airbus and air-vehicles increases in the world. The very high capacity air craft such as from the airbus and air-car company currently developed. The main of this research paper aircraft, airbus and air-car cast is low as compare to currently application of materials. New technologies are being evaluated such as the application of new aircraft, airbus, and air-car in as composite material. This study investigates the feasibility of using the (FML) in the upper part of aircraft, airbus, and air-car that need to be failure resistant.

1. MATERIALS

1. 1 The basic property of the raw materials before making composite aluminum oxide and polyimide nylon based (non-metal).

Table 1

Properties	Aluminum oxide	polyimide
Density	3.89 -3.97 gm/cc	1.41 gm/cm^3
Melting point	2072℃	250 - 300℃
Thermal conductivity	20 – 30 w/m-k	35 w/m-k
Thermal Expansion Coefficient	(6.7 – 7.3) $\times 10^{-6}$ /℃	4.0$\times 10^{-6}$/℃
Dielectric Constant at 25C and 1MHz	8.5 – 8.9 MHz	3.4 MHz
Young modulus	378 GPa	3200 Gap
Tensile strength	4160 MPa	75 -90 Map
Dielectric Strength (KV/Cm)at 25C	100 (KV/Cm)	4000 (KV/Cm)

1.2 Fabrication of the composite and constituent of materials:

In this heeding preparation of mixture quantity of aluminum oxide and polyimide nylon based (non-metal) and analysis of experimental. The specimen dimensions according to ASTM standards for evaluating mechanical properties. Various equipments of the set-up for vacuum bag molding technique. [1] First specimen in composite aluminum oxide and polyimide nylon based (non-metal) both metals ratio of (1:1). [2] Second specimen in composite aluminum oxide and polyimide nylon based (non-metal) both metals ratio of (1.5:1). [3] Third specimen in composite aluminum oxide and polyimide nylon based (non-metal) both metals ratio in weight.

Table 2 making the specimen and constituents' materials quantity in specimen:

Specimen	Aluminum Oxide in Weight	Polyimide fiber Based (non-metal) Weight	Composite
SPECIMEN (1)	1	1	1+1
SPECIMEN (2)	1.5	1	1.5+1
SPECIMEN (3)	1	1.5	1+1.5

2. 1 Molding and casting of raw materials in vacuum BAG molding procedure manufacturing of materials:

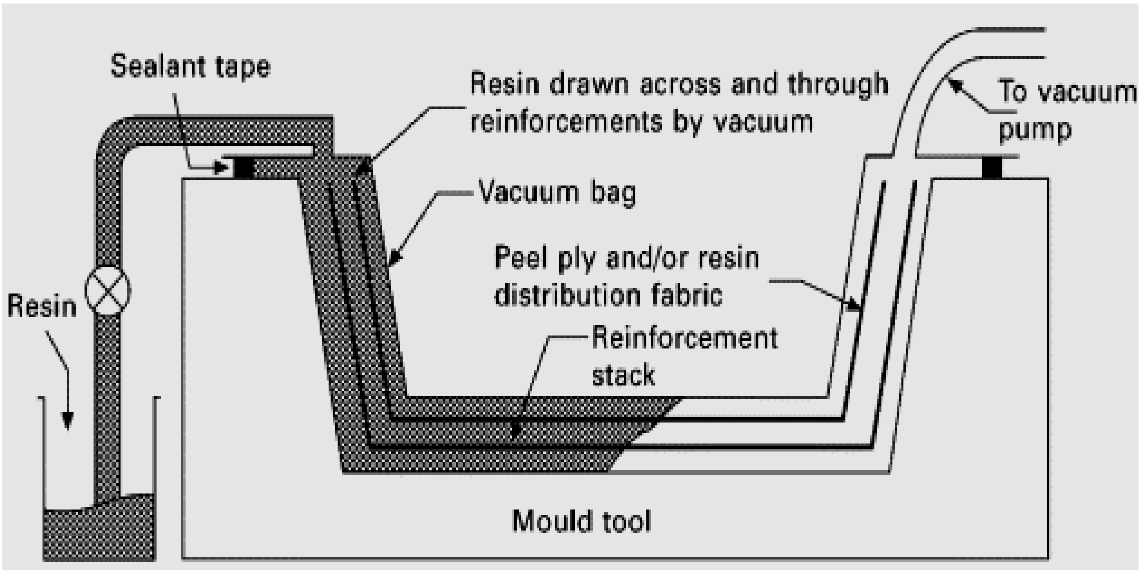

Fig. 1 Vacuum back Molding

The specimens according to ASTM standards for evaluating mechanical properties. All the specimens in material weight ratio different –different all the mechanical properties achieved by

Different- different. Various equipment of layout can be decided by varying the arrangement of order of pure aluminum oxide layer and pure polyimide nylon based (non-metal) layer. The two different layup pattern what we have doing in this experimental analysis such as

2.2. Laminate of the layer producer:

Type 1: AL2O3/Polyimide/ AL2O3/ Polyimide/AL2O3/ Polyimide/AL2O3.

Type 11: Polyimide/AL2O3/Polyimide/AL2O3/Polyimide/AL2O3/Polyimide.

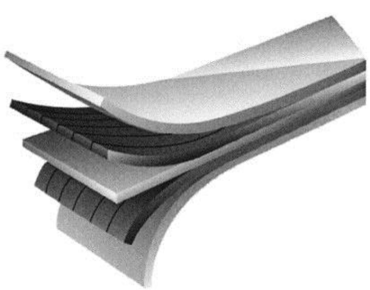

Fig. 2 (a) **Laminate**

Fig. 2 (b): Final Composite Laminate:

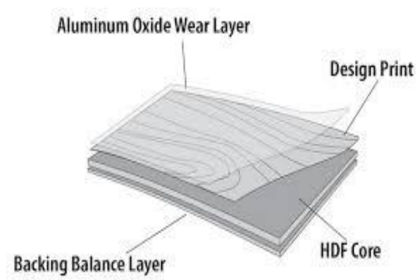

Fig. (c) Final Composite Laminate:

Figure: Final Composite Figure: Final Composite Laminate: Figure: type (1) Figure: Type (2) Figure: Final Composite
Laminate:

3.1 EXPERIMENTAL Set-up SET-UP

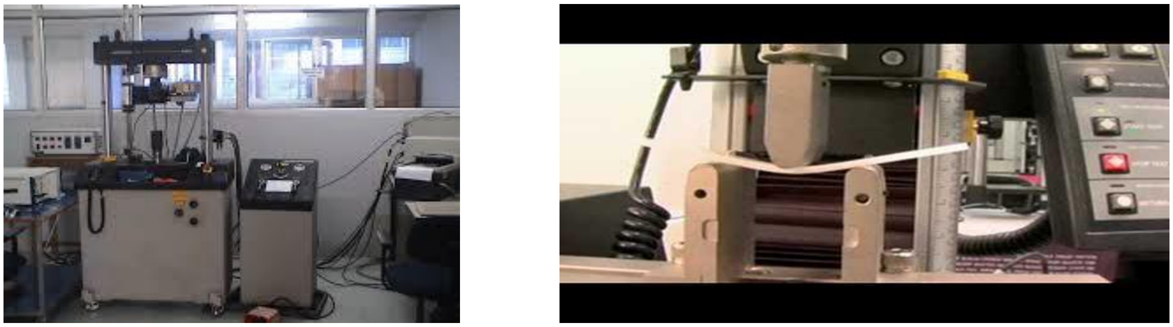

Figure: (3) Tensile test and Bending test of Laminate composites:

Figure: (4) Hardness test and conductivity test of Laminate composites:

4 RESULTS AND DISCUSSION

The tensile test was conducted on three samples of FML composite. The tensile test has carried out by universal testing machine. It is the layer of aluminum oxide and polyimide nylon based (non-metal) layers is increases the modulus of composite systems increases but at the same time the system becomes ductile.

Variation in tensile strength as a function of number of aluminum oxide layers composites is shown in Figure (4) the tensile strength increases with increases in number of layer of polyimide nylon based (non-metal) fiber then the aluminum oxide layer.

This is composites present the most of mechanical commercial applications are based on unidirectional glass fiber pre-pegs which are laid-up between aluminum alloys sheets. However, (FMLs) as classical laminates can be tailored to any engineering application by the choosing different components layers build-up so the new generation is under technological and manufacturing growth.

The strength to weight ratio. Leading to same kind of strength optimizing analysis all the specified FMLs features make lower thickness of higher stress in (FMLs) structures. Possible variations of numerical and Experimental investigations have been performed to analysis by means of (FELs) are hybrid materials.

The tensile test of specifications for tensile testing of standard ASTMD638 each specimen having 30mm width and 280mm gage length. Ceramic fibers: aluminum ($Al2O3$) those are ceramics fabricated by spinning a slurry mix of aluminum particles and additives to perform a yarn which is then subjected to controlled heating fibers retain strength at high Temperature.

The excellent mechanical strength retention for long term in 260 - 315°C (500 - 600°F) range and short in 310°C (700°F) range excellent electrical properties good fire resistance and low smoke emission. Hot molding under pressure and curing temperature is 175°C (350°F) and 315°C all properties of polyimide fiber metal.

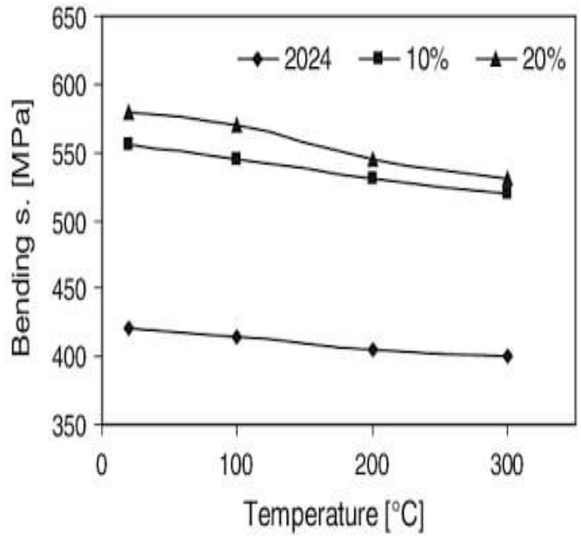

Fig. 5 Bending and temperature result

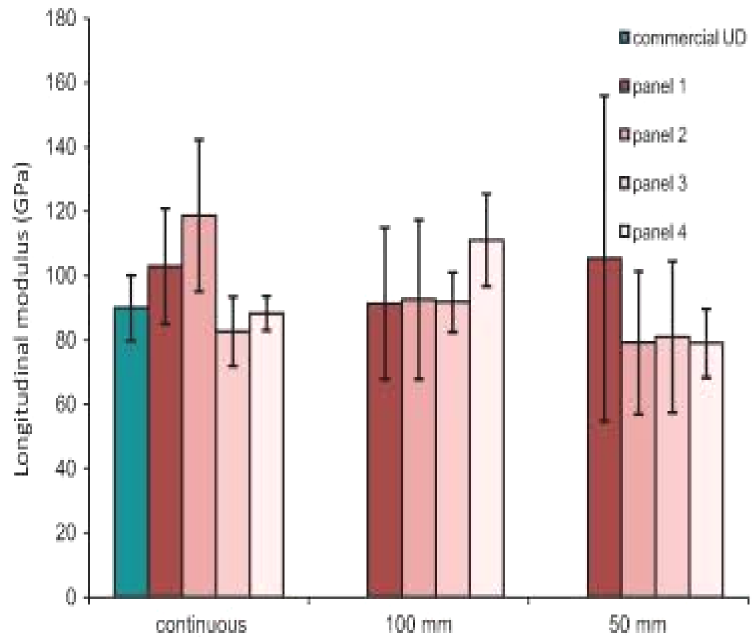

Fig. 6 Flexural Test result

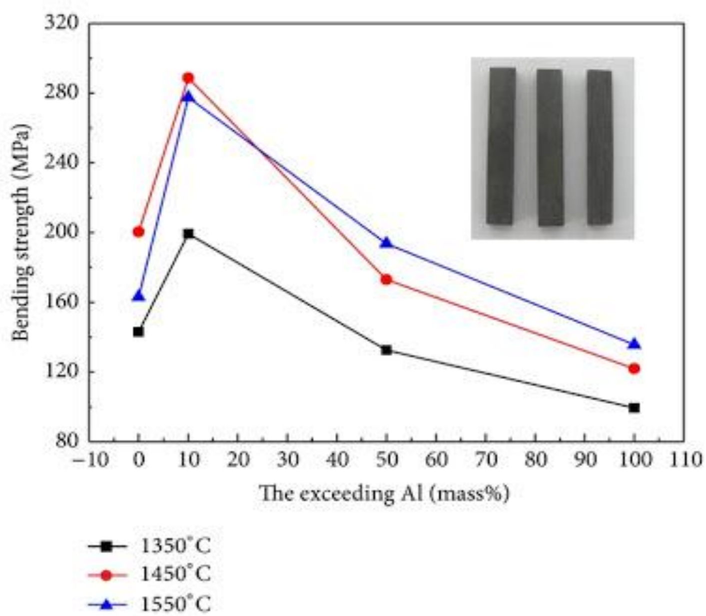

Fig.7 Test of bending and composite of mass

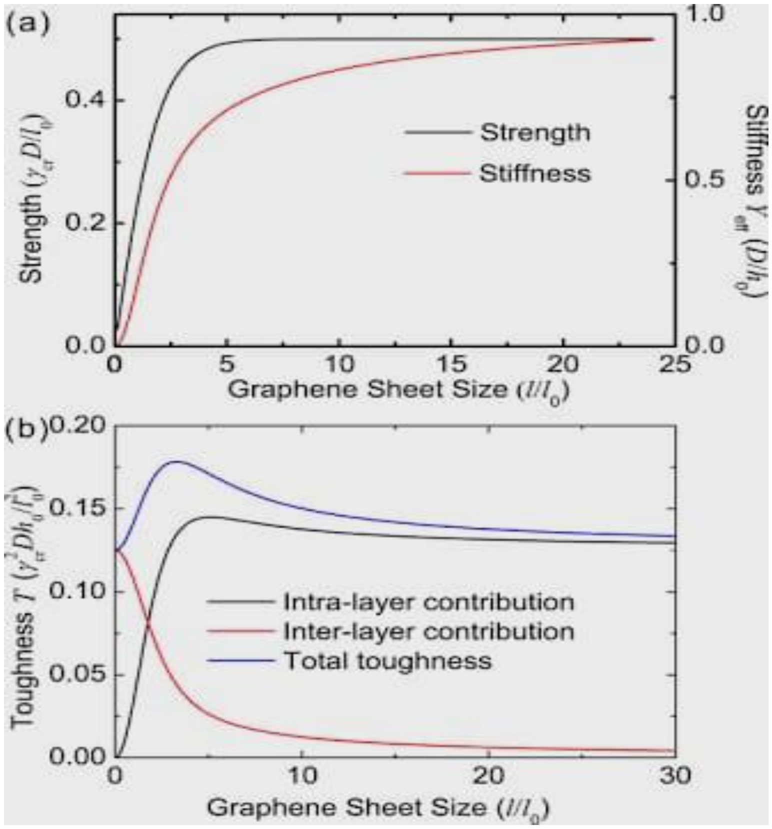

Fig. 8 presented by other properties

This is the application of fiber based composite Aerospace industries, Defenses industries, Nuclear installations, and similar applications demanding high reliability. The superior properties and are now well recognized as materials for extreme environments.

5 CONCLUSION

The paper introduces the concept of (FML), material with the combination of aluminum oxide and polyimide the bonding between (Al2O3) and polyimide fiber metal. The comparisons of compressive Strength of three FML samples are compared the systems exhibited excellent interfacial fracture properties, they could be consider for automotive and Aerospace industries, applications where good structure applications. It is the required under dynamic loading conditions. Optimum layers of (Al2O3) and polyimide fiber for maximum tensile strength 99.5MPa should differ high, i.e. no of layers of polyimide fiber layer. For the specimen having maximum number of polyimide layers lamina withstand more loads without buckling. It is observed that for specimen with more polyimide fiber layer than for than (Al2O3) layer has high and fibers retain strength of high temperature.

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