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An investigation on microstructure and mechanical behaviour of copper-nickel coated carbon fibre reinforced aluminium composites

K Gajalakshmi*, N Senthilkumar†, B Mohan‡ and G Anbuchezhiyan§

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Abstract

In the present investigation, mechanical, corrosion and fatigue characterization is performed on the fabricated aluminium metal matrix composite (AMMC), by reinforcing nickel (Ni) and copper (Cu) coated 4% carbon fibre (CF) in aluminium alloy (AA6026) matrix. With a view of enhancing the strength of the aluminium alloy, an optimal percentage (4 wt%) of CFs is reinforced; as CFs cannot be directly reinforced in the aluminium matrix due to poor wettability, CFs are coated with Ni and Cu using electroless plating technique for better wettability and bonding between reinforcement and matrix. Properties of the cast alloy and coated CF reinforced composite are compared and the composite with better properties is identified as 4% Cu coated CFs reinforced AMMC. When compared with as-cast alloy and Ni coated CF reinforced composite, the tensile strength of Cu coated CFs composite was higher by 15.36% and 2.55%. Similarly, micro-Vickers hardness was improved by 7.61% and 3.09%, impact strength by 19.61% and 3.39%, flexural strength by 87.50% and 15.38%. The corrosion rate (mils/year) was reduced with incorporation of 4% Cu coated CFs in AA6026 by 59.72% and 23.23% as compared with as-cast and Ni coated CF reinforced composition.

1. Introduction

Owing to its significant characteristics such as stiffness, high strength, higher hardness, anti-fatigue, corrosion resistivity, anti-wear, and tear properties the utilization of Aluminum Metal Matrix Composites (AMMCs) has been used for various functional applications. It is also known that the reinforcement carbon fibre (CF) possesses unique properties and it finds for several purposes such as sporting goods, automobiles and the manufacturing of aerospace components as well. The carbon metal-based parts are lighter in weight but they are stronger than its counterpart metals. On considering this CF is being used in the race car industry widely.

Traditional cold chamber die casting machine evolves a production technique that is cost-effective as well as reliable for thorough carbon fibres along with aluminium. Ballmes et al. [1] studied the process parameters and their influence on the infiltration behaviour; further the results were compared to the numerical simulation output. Aluminium (Al) matrix composite reinforced with CFs was fabricated by transferring CF into aluminium liquid using a special flux without applying any external pressure. Baumli et al. [2] found that this type of Al matrix resulted in an in situ TiC-coated CF with wettability along with its oxide-free property which is exhibited in nature. The squeeze infiltration process was used to form AMMC fibres. Abhilash et al. [3] observed that the uniform and better fibres distribution and also the high-quality bonding between fibre and matrix resulted in four times the improvement of composite toughness. By fibre spreading and squeeze casting processes the AMMC reinforced with carbon fibres were fabricated by Li et al. [4]. The structure of the modified interface was examined by utilizing High-Resolution Transmission Electron Microscopy (HR-TEM). Electron
Spectroscopy (ES) is used for chemical analysis. Heat treatment was made to enhance the interface bonding by the chemical reaction that even though improved the bonding nature but the mechanical properties of the composite were degraded. Alternate layers of aluminium sheets and fibre fabrics were hot consolidated to form carbon fibre reinforced composite by the laminate squeeze casting process by Alhashmy et al [5]. This has resulted in a good interfacial bond between the carbon and fibre matrix. By using the liquid stir casting method, the carbon fibre reinforced aluminium alloy 7075 metal along with copper coating was developed as a matrix composite and fabricated as observed by Suhas et al [6]. This has resulted in better wettability between matrix and reinforcement which in turn improved the interface condition that leads to an increase in tensile properties of the composite. Pure aluminium reinforced composite carbon-fibre metal matrix with copper coating was prepared [7], thereby the increase in tensile strength compared to pure aluminium was achieved. It was also noted that there was a uniform carbon fibre distribution with little agglomeration. Deshpande et al [8] fabricated uncoated and nickel-coated CF reinforce in an aluminium matrix, to form a composite, through powder metallurgy method and found that fibre has excellent bonding with the matrix. The hardness of uncoated carbon fibre reinforced composite is decreasing with an increase in carbon fibre content. In the case of coated fibre reinforcement, it is working out in vice versa. Preparation of aluminium metal matrix composite with the varied proportion of long carbon fibre reinforcement along with copper coating is done by Singha et al [9], which resulted in uniform distribution of reinforcement at 4% and tensile properties increases till 4% reinforcement content. Manufacturing of aluminium metal composite with short carbon fibre reinforced along with nickel coating is done [10], which resulted in increased tensile properties.

The novelty of this present work is to incorporate the optimal weight percentage (4%) of CFs in AA6026 matrix using the compo-casting method. CFs was coated with different materials (nickel (Ni) and copper (Cu)) so that the wettability and bonding between reinforcement and matrix can be improved. After fabrication, the as-cast alloy and 4% Cu and Ni coated CFs reinforced composite is subjected to material characterization by performing mechanical tests (tensile, impact, flexural and micro-hardness), fatigue and corrosion tests as per ASTM standard and comparison is made; the better material is identified for the intended purpose.

### 2. Selection of matrix and reinforcements

AA6026 is a currently developed aluminium alloy meeting the European Environmental Protection Directives: 2000/53/CE-ELV for the automotive sector. This alloy has been used as matrix material due to its low weight, higher wear resistance and superior corrosion resistant properties, better welding capability compared to other groups of aluminium alloys such as 6081 or 6082 and its chemical composition is shown in table 1.

Figure 1 shows EDAX spectrum of as-received AA6026-T9 condition, which consists of the aluminium element as a major constituent, and minor constituents of magnesium, copper, zinc, chromium, ferrous, silicon, bismuth, manganese and other traces, relating to the chemical composition of AA6026 alloy. SEM image shows the distribution of grain particles, its size and its grain boundaries.

The strong and thin crystalline filaments of carbon fibres reinforcement with diameters at the micron level are primarily used for synthesizing aluminium composites. These materials are very lightweight and strong compared to steel and it has excellent properties such as high stiffness, high chemical resistance, high tensile strength, low thermal expansion, high fatigue resistance, excellent creep resistance and high-temperature tolerance. This phenomenon made carbon fibre to be widely preferred by engineers and designers for manufacturing functional materials in order to improve the properties of base materials. Generally, CFS is widely defined as fibres containing at least 92 and up to 100 wt.% carbon. Moreover, CFs are polycrystalline, and usually in the non-graphitic stage and possess a two-dimensional long-range order of carbon atoms in planar hexagonal networks, but without any measurable crystallographic order in the third direction (z-direction). Carbon fibres/Al composites have already been used in Hubble Space Telescope, cargo bay of space shuttles, flywheels for energy storage, high-speed motors retainer rings, brake callipers for automobiles and in thermal management. CFs have been extensively used in composites in the form of woven textiles, prepregs, continuous fibres/rovings, and chopped fibres [11]. By incorporating CFs as reinforcements in composites, it becomes more resistant and stiffer than the conventional materials and the material becomes lightweight due to lower density [12]. CFs exhibit a negative coefficient of thermal expansion, which is balanced by the positive thermal expansion coefficient of matrix materials, resulting in zero coefficient of thermal expansion, for the specific

| Element | Mn | Fe | Mg | Si | Cu | Pb | Bi | Zn | Sn | Cr | Al |
|---------|----|----|----|----|----|----|----|----|----|----|----|
| %       | 0.24 | 0.22 | 0.68 | 1.22 | 0.18 | 0.41 | 0.13 | 0.78 | 0.05 | 0.16 | 95.93 |
application in space structure and finely tuned optical types of equipment. The melting temperature of carbon fibres is around 3600 °C. It is also inferred that CF strengthened aluminium alloy induces brittle intermetallic phases which exhibits undesirable behaviour in synthesized composites. This can be eliminated by coating suitable alloying element with carbon fibres. The most commonly used alloying element for coating carbon fibre is nickel and copper, which is selected in this present work. Figure 2 shows the chopped carbon fibres used in this present work and the photographic view of Ni and Cu coating using the electroless coating.

3. Experimental methodology

3.1. Electroless plating
Electroless plating processes are used when it is necessary to obtain a very uniform coating on complex geometries because these processes do not depend on electricity delivered from a rectifier. As the name implies, the coating is produced without an outside source of current, the reducing electrons are provided chemically.

Procedure for coating nickel and copper on carbon fibre is as follows:

1. Preheat the chopped CFs in a muffle furnace for 10 min at 45 °C.
2. Clean the preheated CF with immersing it in a bath of Acetone for 1 h and then wash it with distilled water for removing the glue.
3. Again, treat the CF with (30 g l⁻¹ SnCl₂, 60 ml l⁻¹ HCl) for 15 min with the assistance of Ultrasonic Vibration for Sensitization.
4. Clean the CF with distilled water.

5. Again, treat the CF with \((0.25 \text{ g l}^{-1} \text{ PdCl}_2, 60 \text{ ml l}^{-1} \text{ HCl})\) for 15 min with the assistance of Ultrasonic Vibration for Activation.

6. Clean the CF with distilled water.

7. Immerse the CF in a bath containing the solutions of:
   a. \(\text{CuSO}_4 \cdot 5\text{H}_2\text{O} = 10 \text{ g l}^{-1}\) (For Nickel coating use \(\text{NiSO}_4 \cdot 5\text{H}_2\text{O}\) (Copper Sulphate/Nickel Sulphate)
   b. \(\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O} = 20 \text{ g l}^{-1}\) (Potassium sodium tartrate—Chelating Agent)
   c. \(\text{NaOH} = 12 \text{ g l}^{-1}\) (Sodium Hydroxide—For maintaining pH value)
   d. \(\text{NaH}_2\text{PO}_2 = 15 \text{ g l}^{-1}\) (Sodium Hydro phosphate—Reducing Agent)

After the process of electroplating, the Cu and Ni coated CFs were dried up by heating it in the electric furnace and packed in an air-tight container for further processing.

3.2. Compocasting

Compocasting, or rheocasting, suggested by Mehrabian \textit{et al} [13] in the early 70 s, is a semi-solid method used to produce metal-matrix composites, mainly short-fibre/aluminium-matrix composites. The process of casting slurry, where the liquid metal is held between the liquidus and solidus temperatures, is called rheocasting. The reinforcement either in the form of particulates, whiskers, or short fibres is added to this slurry before casting. Compocasting technique is a better fabricating method for AMMCs for delivering uniform distribution of reinforcements with enhanced wettability. In semi-solid slurry, the reinforcing phases get entrapped due to vigorous mechanical stirring and prevent their segregation due to gravity and simultaneously lower their tendency to agglomerate. With lower shrinkage of matrix alloy, less porosity can be achieved. For fabricating of AMMCs and as-cast specimens, the AA6026 (1390 gm) ingots with 38 g of Cu and Ni attributed to die dimensions has been utilized to synthesis aluminium composites. The alloys are cut into smaller pieces and fed into the crucible and heated to around 700 °C for melting. Simultaneously the coated CFs are preheated around 450 °C and added to the semi-solid slurry and vigorously stirred for 10 min with stirring speed of 300 rpm. Finally, the prepared slurry is bottom-poured into a permanent die-cast as per the required dimensions 115*115*25 mm respectively. Figure 3 shows the photographic and schematic illustration of compo-casting setup.

3.3. Performance measures of synthesized composites

The fabricated composites’ mechanical properties are characterized by performing the tensile test, micro-hardness, impact and flexural test. For determining the mechanical properties like tensile strength, percentage elongation and stress-strain relationship, the tensile test was carried out with the casted specimens prepared per ASTM E8 standard [14, 15]. Vickers microhardness testing machine is used for conducting the micro-hardness test [16, 17]. Impact test gives information about the response of a known material’s specimen to suddenly
applied load and the output is revealed as the energy needed to fracture the composite test specimen. For the impact test, the rectangular specimen was cast and then machined as per ASTM E23. The other name for flexural testing is transverse beam testing, which is used to evaluate the bending or flexure properties of a material. The flexural strength value indicates the highest stress value to which a material is exposed before rupture [18].

The habitual intention of a flexure test is to compute the flexural modulus and flexural strength of the material as per ASTM D790 standard [19]. Fatigue strength is almost certainly the most quality-sensitive of the engineering properties because the flaws of real-life processes have a crucial effect on the fatigue performance of the material [20, 21]. The fatigue test was conducted as per ASTM standard E466. During the fatigue test, one complete stress cycle in a time domain is related to a closed hysteresis loop in the local stress-strain coordinate and consists of two reversals. The reversal can be described as the event of unloading or loading [22].

Electrochemical impedance spectroscopy (EIS) technique that uses an alternating current (AC) as the source of input to the system instead of the direct current (DC) source was utilized to conduct the corrosion test as per ASTM G106 standard [23, 24].

4. Results and discussion

4.1. Metallographic studies

For identifying the distribution, the orientation of the reinforced CFs in the matrix of AA6026, optical image and SEM images were taken. Figure 4 reveals the microstructure of AA6026 matrix with reinforcement of copper-coated 4% CFs, the optical microscope was captured with a magnification of 100 X. CFs was reinforced uniformly, with orientation in both transverse and longitudinal directions. The matrix shows the inter-dendritic pattern of grains of the primary aluminium phase in which the fibres are dispersed as dark patches. The long dark lines at the grain boundaries are fibres. The fibres are dispersed in different orientations in the aluminium phase [3]. Uniform distribution was achieved through compo casting technique, by blending the CFs in AA6026 matrix that existed in a semi-solid state, with uniform stirring and transferring into the die for specified dimension. From the SEM image, it was identified that the dispersed CFs were 3 mm in length and 5 microns in diameter which has been uniformly spread in the matrix.

Figure 5 shows the micrographs of 4% nickel-coated CFs reinforced with AA6026 matrix. The optical microscope was captured at a magnification of 100 X, the matrix shows the inter-dendritic pattern of grains of primary aluminium phase in which the fibres were dispersed as dark circles, and the long dark lines at grain boundaries are CFs. The CFs is dispersed uniformly in different orientations in the aluminium phase. The SEM image also clearly shows the three-dimensional image of copper-coated CF dispersed in the aluminium matrix.

When comparing the microstructures of 4% copper and 4% nickel-coated CFs, it was revealed that 4% copper coated CFs reinforced in AMMC has shown better uniform dispersion of CFs in the matrix material than nickel-coated CFs.

4.2. Mechanical characterization

The fabricated fibre-reinforced AMMC was characterized for its mechanical properties like tensile strength, micro-hardness, impact strength, and flexural strength in accordance with ASTM standards, the outcomes are tabulated in table 2, for two different composite materials, reinforced with copper and nickel coated CFs in
Figure 5. Micrographs of 4% nickel-coated CFs in AA6026.

Table 2. Mechanical Properties of CF reinforced AA6026 AMMC.

| Sl. no | Properties                  | As cast AA6026 | 4% Ni coated CF | 4% Cu coated CF |
|-------|-----------------------------|----------------|-----------------|-----------------|
| 1     | Tensile Strength (MPa)      | 157.72         | 177.42          | 181.94          |
| 2     | % Elongation                | 3.37%          | 8.33%           | 9%              |
| 3     | Micro-Vickers Hardness (HV) | 77.5           | 80.9            | 83.4            |
| 4     | Impact Strength (J)         | 5.1            | 5.9             | 6.1             |
| 5     | Ultimate Flexural Strength (MPa) | 8.0       | 13.0            | 15.0            |
| 6     | Ultimate Breaking Load (kN) | 0.555          | 0.835           | 1.015           |
| 7     | Corrosion Rate (mm/year)    | 2.1544         | 1.303           | 0.8678033       |
| 8     | Corrosion Rate (mils/year)  | 84.82          | 44.503          | 34.165          |
| 9     | Fatigue Strength (No. of life cycles) | 11206   | 17954           | 46023           |

AA6026 matrix. Figure 6 shows the specimens used for characterizing the as-cast and coated CF reinforced composite.

4.2.1. Tensile strength of CF reinforced AMMC

The tensile properties for base materials and coated composites have been performed as per ASTM E8 standards using universal the testing machine of maximum load range of 10 ton with a crosshead speed of 0.5 mm min\(^{-1}\). This characteristic is carried out for identifying the effectiveness and performance of developed composites when applying a pull forced under specific environments and conditions for defining the extreme load or strength the material that can normally bear [25]. Figure 7 implicates that the tensile strength and % elongation of both copper and nickel coated CFs reinforced in the matrix of AA6026. Observation shows that, with the inclusion of CFs, the composite’s tensile strength gets increased and copper coated CF reinforced AA6026 based composite recorded the highest tensile strength than nickel-coated composites [26]. Similarly, the % elongation of the composite increases drastically with the addition of CFs, i.e., the ductility of the composite gets increased with improved strength [27]. In this case, also, copper-coated CF outplays their nickel counterpart, with higher wettability towards aluminium alloy matrix [28]. The fracturing of composites during the tensile the test reveals that, due to the strong fibre-matrix interface, the fibres ahead of the matrix broke initially and the left-out matrix bridges then break down in an absolute ductile manner [29].

The stress-strain curve of the coated CFs reinforced AA6026 matrix and as-cast is compared as in figure 8. Observation shows that the composite reinforced with copper-coated CF sustained to the greater intensity of stress (load) than the nickel-coated CF reinforced composite and as-cast AA6026 alloy. This is due to the hindrance of dislocation by the strengthening mechanism of the reinforcement. On the other hand, compo casting method has been used to develop aluminium composites. It is well known that using this method the porosity is reduced to the maximum and further grain refinement is achieved. It is also considered to be an essential factor to increase the tensile strength of synthesized aluminium composites.
Figure 6. Tested Specimens (a) Micro-hardness (b) Corrosion (c) Fatigue (d) Flexural (e) Impact and (f) Tensile.

Figure 7. Tensile test results of fabricated composites.
4.2.2. Micro-hardness and impact strength of CF reinforced AMMC

The fundamental characteristic of a material is its hardness, which is not the basic physical quantity. The test performed for identifying the suitability of any material for a particular application, where the material is subjected to bending, cutting and scratching is the hardness test. The hardness of fabricated aluminium coated composite is persistent by utilizing micro Vickers hardness test with a load range of 10 grams to 1 kg are shown in figure 9. To perform an appropriate hardness value the averages of 5 readings have been taken out at different locations of synthesized composites of varying coating percentage and it is incorporated in the present study. A considerable increase in micro-hardness value was obtained with reinforcing CFs, which strengths the matrix by taking up the load before the matrix through Orowan strengthening mechanism, resisting the pullout and breakage of reinforcement with the matrix and due to increasing deboning energy of interface and the Pull-out/Bridging mechanism of CF toughening. In this also, the copper-coated CFs perform well than the nickel-coated CFs due to higher wettability behaviour.

For determining the behaviour of materials at extreme deformation speeds and the quantity of energy absorbed during fracture by the material towards determining the impact strength, toughness and fracture resistance is performed through impact test. The Impact strength of developed composites has been measured as
per ASTM E23 standard using Izod impact testing machine. It has been observed that the coated CFs reinforced AA6026 composite presented in figure 8 shows that copper-coated CFs can absorb more energy than that of the as-cast and nickel-coated CF-based composite. During the impact test, instead of the matrix, the CFs bear the load until the fibres secede from the matrix or the fibres rupture [7].

4.2.3. Flexural strength of CF reinforced AMMC
In the present study ASTM D790–17 Flexural test, also called a three-point bending test, was performed for revealing the flexural or resistance to bending strength of a material. Due to the high strength and load-bearing capacity and flexibility of the CFs, the flexural strength was improved significantly with the addition of CFs in the matrix of AA6026 [34], as shown in figure 10. With nickel-coated CFs, the flexural strength was improved by 62.5%, whereas with the addition of copper-coated CFs, the flexural strength was improved by 87.5%. Similarly, the ultimate breaking load was higher for copper-coated CFs by 82.88% due to higher bonding strength and resistance to fibre pull-out due to surface treatment and coating of CFs [35].

4.3. Fatigue studies on synthesized composites
A fatigue test has been performed as per ASTM E1942–98 with a high number of cycles (≥108) of sine waveforms [36, 37]. When the composite materials subjected to fatigue tests, a limiting factor is considered as frequency. In contradicting to metals; the fatigue life of composite materials’ fatigue life is substantially impaired by the testing frequency. The fatigue life depends on the loading frequency since at higher frequencies, heating of material occurs and at lower frequencies, creep-fatigue occurs [38].Figure 11 shows the number of cycles that the specimens can withstand during the fatigue loading. It has been found that the fatigue strength of intermixture with coated CFs significantly increased compared with base materials due to the higher strength as cited in the literature [10]. It is also clearly identified that when compared with nickel coated CF reinforcement, copper-coated CFs produce extraordinary fatigue strength due to higher bonding and interfacial strength owing to its vulnerable to fatigue loading. It is also noted that during straining the delaminated fibres inclines to collapse and hence flaws occur on the developed composites. This initiates a stress concentration at the interface and in the matrix. As a result of that micro-cracks get induced, which further enlarges in fatigue, making those fibres impotent and causes failure [39].

4.4. Corrosion resistant of synthesized AMMCs
The effect of CF addition towards determining the corrosion-resistant of the fabricated coated CFs reinforced AA6026 composite was characterized by Electrochemical Impedance Spectroscopy (EIS) of ASTM G106 to identify the oxidation behaviour of composites when subjected to high temperature, corrosive environments, and humidity. The primary objective of this corrosion study is to prevent, solve or mitigate corrosion-related
As shown in figure 12, for the as-cast specimen of AA6026, the corrosion rate is higher, but with reinforcing coated CFs, the corrosion rate was decreased by 39.52% and 59.72% for nickel and copper coated CFs. For as-cast specimen, when exposed to corrosive NaCl solution and a protective layer of thin-film aluminium hydroxide compound was formed, which protects the base material from the further aggressive environment [41]. But with the inclusion of coated CFs, higher interfacial bonding that exists between the Al matrix and fibre, resists corrosion [42] and electron trade essential for oxygen diminishment becomes easier due to the more conductive stage at intermits driving the anodic reaction to a higher level [43].

For identifying the kinetic parameters, EIS corrosion test was carried out for the fabricated coated CF reinforced AMMC and as-cast specimens, in 3.5% NaCl solution, immersed for 1 h and the potentiodynamic polarization curve and Icorr values obtained are presented in figure 13. The polarization curve of Cu-coated CFs
reinforced composite shifted towards more positive potential than the as-cast AA6026 and Ni-coated CFs reinforced composites. The result confirmed that Cu-coated CFs reinforced composite has higher corrosion resistance than the others. The as-cast and Ni-coated CFs composite may have many pits and micro-cracks that increases the corrosion rate in the corrosive environment [44]. Tafel plot is a graphical representation of log (current) Versus over potential. In Tafel plot, with small overpotentials (<50 mV), the slope of the curve tends to increase as the backward reaction becomes greater than 1% of forwarding reaction, thus changing the relative concentrations at the surface of the electrode. When higher overpotentials greater than a few hundred mV are applied, the slope deviates below the predicted values due to limitations in mass-transfer characteristics. Tafel plots consist of the anodic branch for positive overpotentials and cathodic branch for negative over potential [45].

Tafel’s extrapolation method was used to determine the corrosion current density (I_{corr}) their values are presented in figure 13. The lower corrosion current density value indicates that the Cu-coated CFs reinforced composite possesses higher corrosion resistance than the others. During fabrication of AMMC, interfaces formed between the matrix and CFs inhibits the rate of corrosion thus improving the corrosion resistance and reduces the weight loss of specimens during the test [46].

5. Conclusions

In the present investigations, carbon fibres strengthened aluminium matrix composites by semi-solid processing method is substantially utilized to synthesis and characterizes aluminium composites. From the experimentation, it is determined that by using such a method the physical properties has been increased compared with liquid metallurgy method and solid phase method [47, 48]. Furthermore, in the current scenario, CFs are coated with nickel and copper by electroless plating technique for improving the wettability and bonding with the metal matrix during composite fabrication. Using the compo-casting (semi-solid) fabrication method, the as-cast AA6026, Cu and Ni coated 4% of CFs by weight are reinforced in AA6026 matrix and their mechanical, fatigue and corrosion behaviour are studied. The outcomes from the characterization studies are as follows:

- Metallographic studies were done by capturing optical and SEM images show a better uniform distribution of Cu coated CFs reinforced AA6026 matrix when compared to Ni coated CFs reinforced AA6026 matrix.
- The tensile strength and % elongation of Cu coated 4% CFs reinforced AMMC is increased by 15.36% and 167.06% when compared with as-cast AA6026 and increased by 2.55% and 8.04% when compared with Ni coated 4% CFs reinforced AMMC.
- Micro-Vickers hardness and impact strength of Cu coated 4% CFs AMMC is higher by 7.61% and 19.61% when compared with as-cast AA6026 and when compared with Ni coated 4% CFs AMMC, the properties are higher by 3.09% and 3.39%.
- 87.50% and 82.88% improvement in ultimate flexural strength and ultimate breaking load is obtained with Cu coated 4% CFs AMMC as compared with as-cast AA6026 and 15.38% and 21.56% improved was noticed as compared with Ni coated 4% CFs AMMC.
• When compared with as-cast and Ni coated CFs AMMCs, Cu coated 4% CFs AMMC produces 59.72% and 23.23% lesser corrosion rate. The polarization curve of Cu-coated CFs reinforced composite shifted towards more positive potential than the as-cast AA6026 and Ni-coated CFs reinforced composites and hence it higher corrosion resistance than the others due to the formed interfaces between the matrix and coated CFs.

• A drastic increase in fatigue strength was achieved with reinforcement of CFs in AMMC. When compared with as-cast, Ni coated 4% CFs AMMC shows 60.22% increase in fatigue strength, whereas the fatigue strength of Cu coated 4% CFs AMMC shows 310.70% increase in fatigue strength. When compared among the AMMCs, Cu coated CFs AMMC shows 156.34% higher fatigue strength than Ni coated CFs AMMC.

ORCID iDs

N Senthilkumar https://orcid.org/0000-0002-2441-1061
G Anbucezhian https://orcid.org/0000-0001-7346-8876

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