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INTERFACE INVESTIGATION STUDY IN POLYMER CERAMIC BAONDING-A REVIEW

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ABSTRACT: An Important aspect with respect to optimal mechanical performance of fibre reinforced composites in general and durability in particular is the optimization of the interfacial bond between fibre and non-metallic materials. The quality of the fibre-matrix interface is significant for the application of natural fibres as reinforcement for epoxy resin. Since the fibres and matrices are strong adhesion at their interfaces is needed for an effective transfer of stress and bond distribution throughout an Interface. This article gives a critical review on the mechanical properties and chemical treatments, bonding methods that improve the fibre-matrix adhesion and their characterization methods.
Keywords: Natural fibre, ceramic, polymers, bonding, interface, tensile, impact properties

I. INTRODUCTION

In composites like polymers and ceramics have contrasting physical and chemical properties. Polymers constitute another important class of materials. It is immediately obvious that they are different from metals and ceramics. They are generally lightweight, which reflects their composition: they are organic materials, consisting mostly of carbon and hydrogen atoms. Polymers are usually transparent or they have strong colours because dyes have been incorporated in them and excellent electric insulators. Their valence electrons reside in filled bands. Mechanically, polymers are much softer, weaker and less rigid than either metals or ceramics; they melt at relatively low temperatures. Clearly, a much weaker chemical bond is involved: polymers are held together by secondary bonds. Some primary bonds are involved in a class of polymers called thermo sets these primary bonds between chains are called cross links. Thermo set polymers are synthesized by a chemical reaction between two different substances. Usually, one of the substances consists of large hydrocarbon molecules and is called the resin. The other substance binds the resin molecules chemically together rand is called the hardener. With primary (strong) bonds between the chains, thermosets are stronger and stable to somewhat higher temperatures than the thermoplastics. They do not soften at high temperatures but lose their hydrogen and transform into char at high temperature. As a consequence, thermosets are not recyclable. Thermosets are used in some applications where high-temperature stability is essential. They are also used as matrix in fibre-reinforced composites (fibre-glass or graphite fibres) because the fabrication of large objects, such as boats, car bodies or airplane parts vastly benefits from the ability of a thermoset to solidify at room temperature. Inter-atomic bonds are primarily of two kinds: Primary bonds and Secondary bonds. Ionic, Covalent and Metallic bonds are relatively very strong, and grouped as primary bonds, whereas van der Waals and hydrogen bonds are relatively weak, and termed as secondary bonds. Metals and Ceramics are entirely held together by primary bonds - the ionic and covalent bonds in ceramics, and the metallic and covalent bonds in metals. Although much weaker than primary bonds, secondary bonds are still very important. They provide the links between polymer molecules in polyethylene (and other polymers) which make them solids.Polymer molecules are huge, macromolecules that have internal covalent bonds. For most polymers, these molecules form very long chains. Polymers consist of large number of molecular chains which are usually not linear; bending and rotations can occur around single C-C bonds (double and triple bonds are very rigid their applications are Space Applications, Space Transportation Systems, Military, Bio-production, Research and development priorities, Environmental effects, Future trends inPMCs can be reinforced with individual, rigidrod-like molecules or with fibres generated fromthese molecules.[26]

II. DISSIMILAR BONDING

Dissimilar bonding means combining of two or more different materials. Porous silicon carbide (SiC) ceramics have been increasingly studied because they were proved to exhibit unique combination of good oxidation resistance and thermal-shock resistance as well as excellent mechanical and chemical stability due to the covalent nature of Si–Cbonds, Si Cceramics normally needed to be sintered thigh temperatures or/and with the addition of sintering agents, which have limited the application of porous SiCceramics. New processing routes that overcome these problems are the pre-ceramic polymer processes, during which the polymer precursors convert into ceramic materials. These processes have the advantage of requiring unusually low temperatures (1000~12008C) the application area of polymer-derived ceramics lie in wide range of fibers, coatings, binders, and ceramic matrix composites [27]

III. BONDING IMPORTANCE

Bonding is mostly used in industry field. Bonding is the surface-to-surface assembly of similar or dissimilar materials using a substance which usually isofa dissimilar type, and which observes to the surfaces of the two adherents to be joined, transmitting the forces from one adherent to the other. Anadhesivesa non-metallic substance capable of joining materials by surface bonding(adhesion),and the bond having appropriate internal strength(cohesion Bonding is the most common joining technique. Essentially all precisely useful material scan be joined with each other, and one with alternative, by means of this surface-to-surface and material-joining method. Adhesive bonding technology suggestions abundant design flexibility as it can be easily incorporated into almost all offered industrial structures of single-piece work or mass production. Appropriate bonding process improves end use performance, increase efficiency. Bonding has long been familiar as a high-performance joining method. The large popular of original natural binding materials have now been replaced by unnaturally prepared adhesives. Bonding rarely competes with other joining techniques used in industry. One of the many advantages of bonding is that no heatis needed to create the joint [25]

IV. LITERATURE SURVEY

Ola abdelwahab [1] examined the adsorption capacity of raw luffafibres for different types of oil and water pickup. The investigation revealed that the efficiency of fibres to remove crude oil from sea water was related to the surface properties of the fibres. SEM of the luffa sorbent shows small number of macro porous structure is confirmed by the low bulk density of the adsorbent. Harriset al [2]investigated the strength of the bond between the ceramic and an epoxy adhesive. Three surface conditions have been characterized as-fired, air re-fired and KrF laser processed. Mechanical testing showed that the adhesive bond strength was improved in both tension and shear, cohesive failure of the adhesive layer which shows the maximum bond strength was achieved. Yoshio Kobayashi et al [3] discussed the Metal–metal bonding was performed using metallic Cu nanoparticles fabricated from CuONanoparticles. A decrease in temperature solidifies the metallic materials and completes themetal–metal bonding.This SEM observation implies that the metallic Cu powders strongly bonded thecopper discs together. Parida et al [4] analysed that the luffacylindrica is modified into bio Nano-composite it has been modified by calcium phosphate and calcium carbonate separately to produce composites of Ca-salts.. Mechanical properties are found to depend on adhesion between fibres and resin as well as fiber loading which requires more resin to wet the fiber in order to have effective mechanical properties. Chayaphum et al [5]studied the method of joining two or more metal sheets by using heat and force to soften and yield an atomic adhesion between the two work layers Using the insufficient heat and force The results shows that a reduction in defect size can be obtained by increasing the work temperature as well as the stamping force. The regression model was also developed to show the relationship of factors to the delamination size. Ruishenget al[6] analysed the Low Temperature Copper to Copper Bonding (LTCCB) technology. The analyses look into the energy and material consumables consumption profiles of LTCCB technology and the Conventional Method (CM) which requires higher bonding temperature Scenario analysis shows that both total unit cost andcarbon footprint of LTCCB technology are lower than that of CM. The recommendation hascertainly improved the eco-efficiency of LTCCB technology. AlirezaAshori[7]investigated that wood-plastic composite is a very promising and sustainable green material to achieve durability without using toxic chemicals, that contains plant fibres and thermoplastics. These bio-based composites will enhance mechanical strength and acoustic performance, reduce material weight and fuel consumption, lower production cost, improve passenger safety and shatterproof performance under extreme temperature changes, and improve biodegradability BalasivanandhaPrabhu et al [8] analysedthe effect of volume fraction of SiC and diameter of the fiber on interfacial stress/strain characteristics of 6061 AL/SiC metal matrix composites. The tensile behaviour of the composite is simulated by using finite element method. the results show that de-bonding is more pronounced in the interfacial element near the axis of symmetry. the de-bonding initiated purely by the shear and maximum shear stress occurs just inside the model at some distance from the free end of the unit cell and it propagate as the load increases.. Jadoon et al[9] studied that metal to ceramic joining via a metallic interlayer bonding technique the results of joining between the high-temperature and corrosion resistant iron-chromium-aluminium alloy (ferroalloy) with silicon nitride by use of metallic interlayer. The result suggests that a thin aluminium nitride, reaction product layer was present on the silicon nitride interface in the joined samples. Joining was also attempted using a Ti/Cu/Ti multilayer and its variations. But it was not possible due to the formation of a brittle reaction product layer, highlighting that wetting and joining are not together. Hiroyuki Kinoshita et al[10] studied that the development of green composite consists of woodchips, bamboo fibres and biodegradable adhesive to improve these defects; it was proposed that a biodegradable resin as an adhesive and bamboo fibres as reinforced fibres were applied to the woodchip composite. It was found that the high bending strength was obtained in the case where woodchips with the small particle size and long bamboo fibres were used, and the high impact strength was obtained in the case where woodchips with the large particle size and long bamboo fibres were used and the particle application for the composite can be expected. TakianFakhrul and Islam[11] investigated that the degradation behaviour of natural fiber reinforced polymer matrix composites these polymer based plastics are substantially resistant to biodegradation. The experimental results revealed that addition of both sawdust and wheat flour considerably improved the biodegradability of PP. The most pronounced biodegradation was exhibited by samples exposed to brine solution and those buried under moist soil.

Nadezada Stevulova et al [12] studied the light weight composites based on hemp hurds and alternative binders, impact of hemp hurds properties mean particle length on the behaviour of composites based on alternative binders. The results shows that the values of the water absorbability increase in the dependence on decreasing mean particle size of hemp hurds slices, whereas the effect of mean length of hemp hurds slices on thermal conductivity coefficient was not confirmed. Padmaraj et al[13] studied that the development of bio-degradable composites using areca nut frond fibres for use in low strength applications. Alkali treatment of areca fibres improved the mechanical properties to some extent. Results reflect that areca fibres can be reinforced with suitable polymers and can be useful for small load carrying applications. Koon-Yang Lee et al [14] analysed that the novel robust non-woven sisal fibre preform was manufactured using a papermaking process utilizing Nano sized bacterial cellulose (BC) as binder for the sisal fibre. It was found that BC provides significant mechanical strength to the sisal fibre performs. By using BC as binder for short sisal fibres, added benefits such as the high Young's modulus of BC, enhanced fibre–fibre and fibre–matrix stress transfer can be utilized in the resulting hierarchical composites. WiphaweeNuthonga et al [15] studied that the improvement of the impact properties of PLA is an addition of fillers or reinforcements. Bamboo fiber, vetiver grass fiber and coconutfiber were used as alternative reinforcements in PLA composites. Bamboo fiber proved to be the most effective reinforcement among all studied reinforcements.In this study, the bamboo fiber proved to bethe most effective reinforcement for the impact strength improvement of natural fiber reinforced PLA composite. Salma M. Naga et al[16] analysis that Laminated Si/SiC ceramics were synthesized from porous preforms of biogenous carbon impregnated with Si slurry at a temperature of 1500 C for 2 h. The SEM micrographs indicate that the final material exhibits a distinguished laminar structure with successive Si/SiClayers. The produced bodies exhibit a distinguished laminar structure with successive Si/SiClayers. The Si content of the composites has a significant effect on the mechanical properties. Dongareet al [17] investigated that, Metal–ceramic composites are an emerging class of materials for use in the next generation high technology applications due to their ability to sustain plastic deformation and resist failure in extreme mechanical environments. The higher strength of the Nano-composite is attributed to the reduced sliding/rotation between the Al/Si and the Si/Si grains as compared to the pure Nano-crystalline metal. Sridharan and Nambi Muthukrishnan [18] analyzed that the bio-composites are less density materials that require less energy during machining and production. Due to hydrophilic nature of fibre, the bonding between matrix and fibre is weak. To enhance this quality, various chemical treatments are used. The result shows the delamination increases with feed rate, the effect of treatment reduces the push down delamination more than peel up delamination, alkali treatment reduces delamination factor slightly. But the effect of fibre treatment on delamination factor is insignificant. Niharika Mohanta and Acharya [19] investigated that a composite using single, double and triple layer luffacylindrica fibre mats. Structure of fibre increases the tensile and flexural strength for double layer composite a decrease in strength for triple layer composite which seem to be due to poor wetting of fibre with the matrix material. A new set of composites with Luffacy lindrica fibre as reinforcement with epoxy resin are successfully fabricated. Lassaad Ghali1et al [20] studied that the unsaturated polyester matrix reinforced with a mat of Luffa external wall fibres a short Luffa external wall fibres and a short Luffa core fibres was fabricated under various conditions of fibres treatments (combined process, acetylating and cyan ethylating) and fibre weight ratio. It resorts that acetylating and cyan ethylating enhance the flexural strength and the flexural modulus. The enhancement of elongation at break and the strain values of the composite reinforced by natural mat were proved. Valcineideet al [21] investigated that the Sponge-gourds bio-composites are a novel resin use of these fibres, but a better understanding of their surface characteristics is necessary to maximize their potential use. The SEM result shows Methacrylamide 3% treatment for all times severely damaged the fibres. NaOH showed the same beneficial effect regarding enhancement of surface area and thermal stability together with similar levels of lignin and hemicellulose extraction, without causing exaggerated harm to fiber integrity. Raghavendra et al [22] analysed that the Natural fibres reinforced bio-degradable composites are good alternative for conventional materials. Natural rubber can successfully use as matrix in bio-composites. Using differentsurface modifications of fibre the strength of the composites can be increased. Syed AltafHussain et al [23] investigated that natural fibres offer a number of advantages over traditional synthetic fibres Tensile strength (TS) and Flexural strength (FS), of short bamboo fiber reinforced polyester composites filled with alumina particulates Addition of alumina (Al2O3) particulate at various proportions as filler material the mechanical properties via,. Tensile strength and flexural strength are distinctly improved. Sakthivel and Ramesh [24] studied that the fabrication of polymer matrix composites by using natural fibres like coir,banana and sisal which are abundant nature in desired shape by the help of various structures of patterns. The material properties of fabricated natural fibre reinforced composites were observed. It is found that polymer banana reinforced natural composites is the best natural composites among the various combination

V. CONCLUSION

In this Studies concluded that the bond strength can be improved between the ceramic and an epoxy adhesive. It has also been concluded that mechanical properties are found to depend on adhesion between fibres and resin. Studies also show that the luffa fibres have high tensile and impact strength. It has been also concluded epoxy resin is a suitable bonding medium for non-metallic materials as well as fibre reinforcement so find out the new alternative materials for some suitable application for low cost hand lay-up technique

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