Rapid Prototype Of Carbon Nano Polymer Matrix Composite Tubes By Particle Depositing Method

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Abstract: In polymer and metal matrix composites that form a strong bond between the fiber and the matrix, the matrix transmits loads from the matrix to the fibers through shear loading at the interface. As a polymer composites NANO polymer particles deposition in a proper way will give improvement in strengthening properties in comparison to normal conventional fabrication methods. 3D rapid prototyping is one of the prominent methods of particle deposition by optimizing model design. This method can give better quality and bonding ability of particles when compared to other methods. In the present research, polymer matrix materials: poly propylene with fly ash NANO particles are fabricated by using metal spraying method. The tubes obtained by this process are tested by OM and SEM for better bonding optimization.

Key words: Fabrication Of Polymer Matrix Composites; Particle Deposition; OM; SEM;

I. INTRODUCTION

Polymer Matrix Composite (PMC) are divided into two categories: Reinforced plastics and advanced composites. The distinction is based on the level of mechanical properties (usually strength and stiffness); however, there is no unambiguous line separating the two.

Reinforced plastics are relatively inexpensive; typically consist of polyester resins reinforced with low-stiffness glass fibers (E-glass). They have been in use for 30 to 40 years in applications such as boat hulls, corrugated sheet, pipe, automotive panels, and sporting goods.

Advanced composites have been in use for only about 15 years, primarily in the aerospace industry, consist of fiber and matrix combinations that yield superior strength and stiffness. They are relatively expensive and typically contain a large percentage of high-performance continuous fibers, such as high-stiffness glass (S-glass), graphite, aramid, or other organic fibers. This assessment primarily focuses on market opportunities for advanced composites. Less than 2 percent of the material used in the reinforced plastics/PMCs industry goes into advanced composites for use in high-technology applications such as aircraft and aerospace.

The continuous reinforcing fibres of advanced composites are responsible for their high strength and stiffness. The most important fibres in current use are glass, graphite and aramid. Other organic fibres, such as oriented polyethylene, are also becoming important. PMCs contain about 60 percent reinforcing fibre by volume. The strength and stiffness of some continuous fiber reinforced PMCs are compared with those of sheet moulding compound and various metals. For instance, unidirectional and high strength graphite/epoxy has three times the specific strength and stiffness in comparison to common metal alloys. Of the continuous fibres, glass has a relatively low stiffness; however, its tensile strength is competitive with the other fibres and its cost is dramatically lower. This combination of properties is likely to ensure that glass fibres remain the most widely used reinforcement for high-volume commercial PMC applications. Aramid and graphite fibres are used when stiffness or weights are at a premium consideration.

II. PROBLEM STATEMENT AND SCOPE OF WORK

Continuous phase preparation of polymer matrix composites is a process of preparing high accurate products in polymers. The preparation of carbon polymers including SiC particles may be better application and it is also an advanced technique for present scenarios. Even though many researches advancing in polymer preparation of carbons advanced interpretation of NANO’s includes with local available polymers is became a major task because of its minute particle size. This study can give a scope of fabrication of NANO carbon fly ash with local polymers like PP, ABS.

Prototyping or model making is one of the important steps to finalize a product design. It helps in conceptualization of a design. Before the start of full production a prototype is usually fabricated and tested. Manual prototyping by a skilled craftsman has been an age- old practice for many centuries. Second phase of prototyping started around mid-1970s, when a soft prototype modeled by 3D curves and surfaces could be stressed in virtual environment, simulated and tested with exact material and other properties. Third and the latest trend of prototyping, i.e., Rapid Prototyping (RP) by layer-by-layer material deposition, started during early 1980s with the enormous growth in Computer Aided Design and Manufacturing (CAD/CAM) technologies when almost
unambiguous solid models with knitted information of edges and surfaces could define a product and also manufacture it by CNC machining.

III. RAPID PROTOTYPING PROCESS

The process belong to the generative (or additive) production processes unlike subtractive or forming processes such as lathing, milling, grinding or coining etc. in which form is shaped by material removal or plastic deformation. In all commercial RP processes, the part is fabricated by deposition of layers contoured in a (x-y) plane two dimensionally. The third dimension (z) results from single layers being stacked up on top of each other, but not as a continuous z-coordinate. Therefore, the prototypes are very exact on the x-y plane but have stair-stepping effect in z-direction. If model is deposited with very fine layers, i.e., smaller z-stepping, model looks like original. RP can be classified into two fundamental process steps namely generation of mathematical layer information and generation of physical layer model. Typical process chain of various RP systems flow chart is shown in fig.1.

Fig.1. RP process chain showing fundamental process steps

IV. TUBE MODELLING

Preparation of tube modelling in carbon NANO tube applications to get better optimization in tube fabrication without deviating design considerations in following applications

1. Surgical applications
2. Aeronautical applications
3. Thermal applications
4. Structural applications

4.1. Fused Deposition

In Fused Deposition Modelling (FDM) process a movable (x-y movement) nozzle on to a substrate deposits thread of molten polymeric material. The build material is heated slightly above (approximately 0.5 C) its melting temperature so that it solidifies within a very short time (approximately 0.1 s) after extrusion and cold-welds to the previous layer as shown in Fig. 2.

Various important factors need to be considered and are steady nozzle and material extrusion rates, addition of support structures for overhanging features and speed of the nozzle head, which affects the slice thickness. More recent FDM systems include two nozzles, one for part material and other for support material as shown in Fig.3. The support material is relatively of poor quality and can be broken easily once the complete part is deposited and is removed from substrate. In more recent FDM technology, water-soluble support structure material is used. Support structure can be deposited with lesser density as compared to part density by providing air gaps between two consecutive roads.

4.2. Cad modeling

It is necessary for 3D prototyping material depositing method to get optimal deposition along flow line for better bonding applications. CAD diagrams of tube lay out, material deposition lay out and material deposition layers layout are presented in Fig.4, Fig.5 and Fig.6 respectively.
4.3. Preparation of composites

The composition of all compatibilizer-free PP composites is summarized in Table 1. In order to compare composites filled with carbon materials in different forms, CNT product was introduced into PP matrix but also carbon black (CB) and commercially available CNT (NC) were applied. As UPNT contained talc as a catalyst carrier in 10 wt%, composites filled with that talc content were also produced. NANO fly ash contained 10 wt% undisclosed catalyst support material according to the product datasheet. In the FBM method a PP in 1:9 mass ratio then the NANO ash was mixed with the neat PP.

Table 1: The composition ratios of matrix.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Pp%</th>
<th>NANO FLYASH</th>
<th>SIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>95</td>
<td>4.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2</td>
<td>97</td>
<td>2.7</td>
<td>0.3</td>
</tr>
</tbody>
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5. RESULTS AND DISCUSSIONS

Fig. 7. The fabricated product of NANO tube

Fig. 8. Schematic of flow line deposition of material

Fig. 9. The surface topology with fly ash

As a part of bonding ability optimization the samples are inspected in standard electronic microscope with different pixels ratios as shown in Fig. 10 to Fig. 13.
As per the results obtained in the OM and SEM the polymer matrix composites in metal depositing method in slow process of 90 minutes in heating depositing and forming with the combination of PP and ABS in same aspect ratio, mixing composites with fly ash and SIC tubes are formed in a proper bonding without getting lashes formation. The integral methods of adding material at certain temperature i.e. 110°C the formations are observed.

VI. CONCLUSIONS

By observing the SEM images some factors shows that fly ash and silica deposits bonded in a proper way as per the depositing technique used in rapid prototyping. Even though physical appearances shows better results there is deep study required in strengthening properties of composites as per the application requirement.

The description of various stages of data preparation and model building has been presented. An attempt has been made to include some important factors to be considered before starting part deposition for proper utilization of potentials of RP processes. While stitching may work very well for some applications, problems may arise, such as micro-cracking, due to the differences in the properties of the stitching materials. More optimisation of these polymer carbons NANO tubes determine by doing conductivity tests such as thermal and electrical, resistivity and CFD approaches of fluid flow according to the application.

VII. REFERENCES


