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PREPARATION, CHARACTERISATION OF ACRYLONITRILE BUTADIENE STYRENE / GRAPHENE POLYMER COMPOSITE MATERIAL THROUGH SOLVENT BLENDING WITH MAGNETIC STIRRER

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Abstract

FDM is an additive manufacturing process, by which material added layer by layer construction. Now days, wide varieties of materials are available for FDM process which extends its application range in aerospace, medical device makers, and limited-production automakers. The FDM materials can be classified as standard materials and application specific materials. This can be useful to parts of almost any shape or size.FDM uses the thermoplastic materials as the filaments such as polyphenylsulfone (PPSF), polycaponate (PC), ABS, ABSi. The objective of this work is to understand the preparation, characterisation of ABS/Graphene polymer composite material through solvent blending technique.ABS is an outstanding thermoplastic material having excellent mechanical, chemical properties and its simplicity of accessibility of companionable with other filler materials. It is essential to improve the strength of ABS material for increasing the use of in FDM process. The carbon nanotubes production cost is very expensive than the grapheme production. In present era grapheme uses in various applications were more with its acceptable properties. In this present work grapheme is blended with ABS through solvent blending method. Chloroform is used as solvent for dissolving the grapheme and ABS by the help of magnetic stirrer.

Key words: FDM, ABS, Applications, Polymer Composite, Thermoplastics, Grapheme and Chloroform.

1. INTRODUCTION

ABS is getting from acrylonitrile, butadiene, and styrene. Acrylonitrile is a synthetic monomer formed from propylene and ammonia; butadiene is a petroleum hydrocarbon derived from butane; and styrene is monomers, extracted from coal [1]. The benefit of ABS is that blended the strength and rigidity of the acrylonitrile and styrene polymers with the toughness of the polybutadiene rubber. The astonishing mechanical properties of ABS are resistance and toughness [2]. Thermoplastic resin can be repeatedly softened by a raise of heat and hardened by a decrease in heat [3]. The thermoplastic resins are Polyethylene, Polypropylene, Poly vinyl chloride, Polystyrene, ABS resin, AAS resin, Acrylic resin, Polyamide/Nylon, Polycarbonate, Polyacetal, Polyphenylene oxide, Saturated polyester, Acetic acid cellulose, [4] Poly acetic acid vinyl, Ethylene-vinylacetateco-polymer, Fluorocarbon Resin, Chlorination polyvinylidene resin, Ionomer resins and other thermoplastic resins [5,6].

2. METHODOLOGY AND EXPERMENTATION

2.1 MATERIALS USED:

Acrylonitrile butadiene styrene (ABS) bought from Sri Swathick polymer suppliers, Chennai, Tamilnadu, India. In the form small black granules are collected. Graphene as nanofiller material bought from AD-Nano products private limited, Bangalore, Maharashtra, India. And Chloroform (i.e. solvent to dissolve ABS & GRAPHENE) a pure liquid bought from Mahadev Scientific's, Kadapa, Andhra Pradesh, India.

2.2 MATERIAL DESCRIPTION:

2.2.1 Acrylonitrile butadiene styrene (ABS): ABS is an amorphous thermoplastic polymer [7] which has the glass transition temperature of about 105°C. It is terpolymer made by acrylonitrile and styrene polymerization in the presence of poly butadiene. Figure.1 shows the arrangement of carbon and hydrogen atoms in ABS [8, 9].

Properties:

Chemical formula	: $(C_8H_8.C_4H_6.C_3H_3N)_n$
Density	: 0.9g/cm^3-1.53g/cm^{3}median 1.07g/cm^3
Thermal conductivity (K)	: 0.1W/m.k
Linear thermal	

Expansion coefficient (α) : 12×10^{-5} k^{-1}

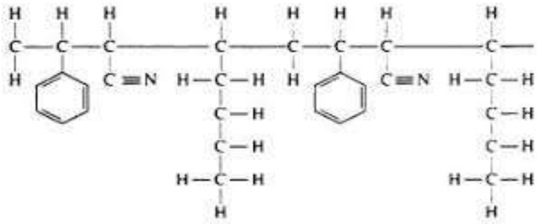


Figure.1 Chemical Bonding of carbon and hydrogen atoms in ABS

2.2.2<u>Graphene</u>: Graphene is allotropy of carbon with a structure of single [10] planar sheet of sp^2 bonded carbon atoms that are densely packed in a honeycomb crystal lattice. It can be produced by combined effort of modified chemical & CVD methods with multiple points of quality checks [11]. Figure.2 shows the SEM image of graphene.

Properties:

Strength	: 130 GPA
Thermal conductivity	: ~5000 W/m.k
Electrical conductivity	: ~10×10^7Siemens/m
Weight	: $0.002 g/m^2$

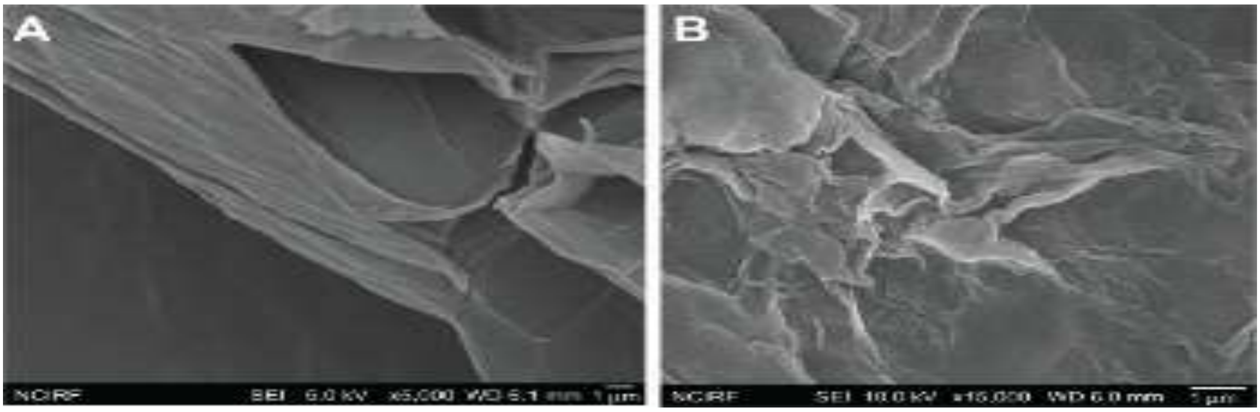


Figure.2 scanning electron microscopy imagery of graphene at range of 1µm

2.3<u>EXPERIMENTATION</u>:

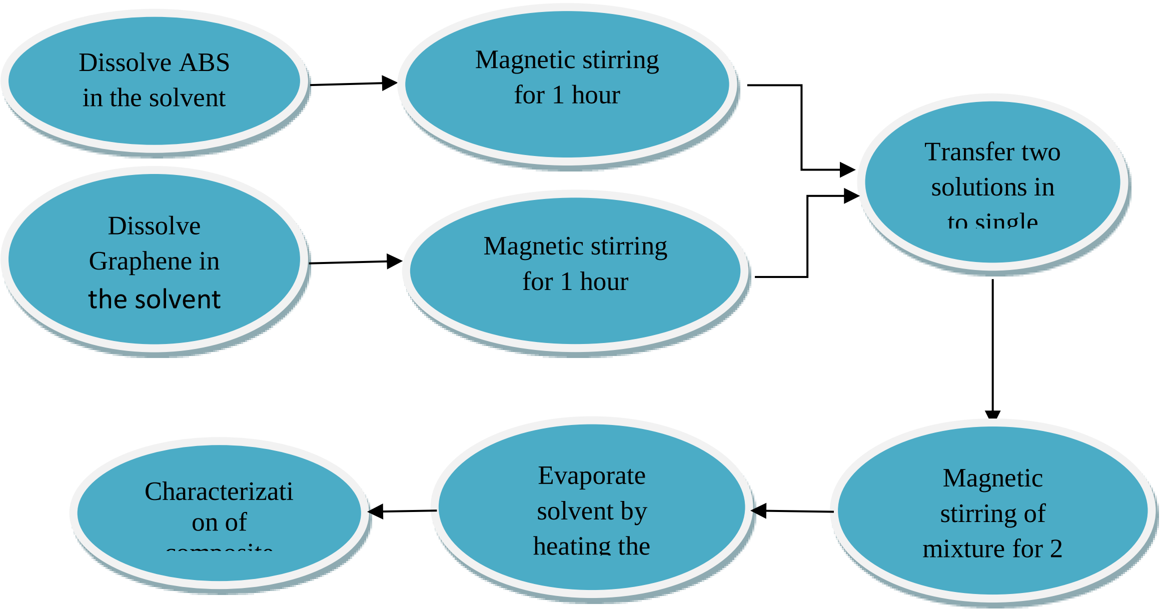


Figure.3 schematic representation of the experimental procedure

The composite materials can easily prepared by following the below procedure, at first dissolve ABS in chloroform at the ratio of 1:5 and dissolve 2.5%of ABS /graphene in the same quantity of chloroform as used for ABS separately. The two solutions are stirred in a magnetic stirrer separately at a speed of 1500 rpm and 1200 rpm for 1 hour. The obtained solutions are poured into same flask and mixed thoroughly by again stirred magnetically in magnetic stirrer for 2 hours at a speed of 1500 rpm to allow graphene filler to completely disperse in ABS molecules. And the mixture is dried in electric oven for 4 hours at 80°c [12].

After the chloroform is completely evaporated, ABS/Graphene nanocomposite is obtained in the form of small irregular pills. Figure. 3 show the detailed description of experimentation in the flow chart.

3. RESULTS AND DISCUSSION

3.1 SEM RESULTS:

Figure.4 (a, b, c, d) shows the SEM images of ABS/GRAPHENE nanocomposite at ranges 5µm, 2µm, 1µm and 500 nm respectively. It appears to be that Graphene filer sheet is successfully interposed into ABS polymer molecular structure.

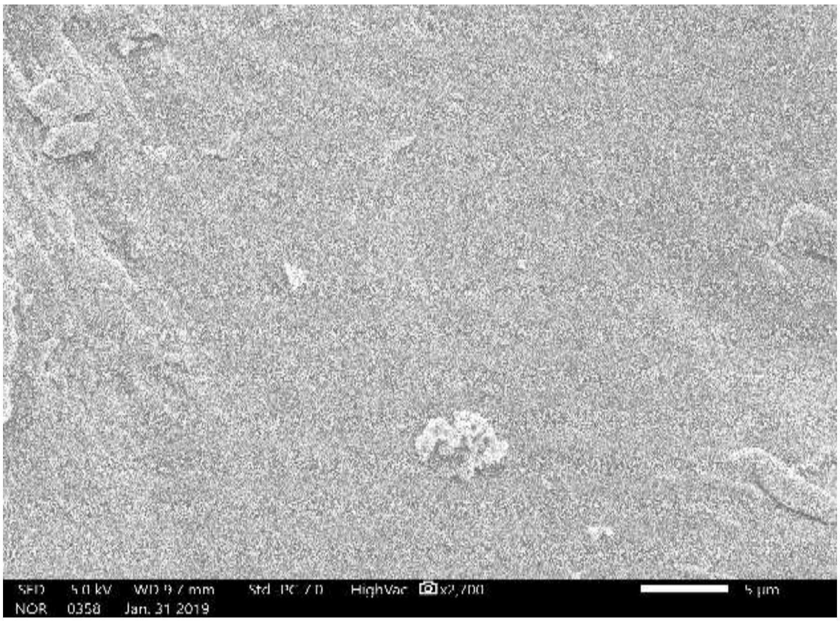
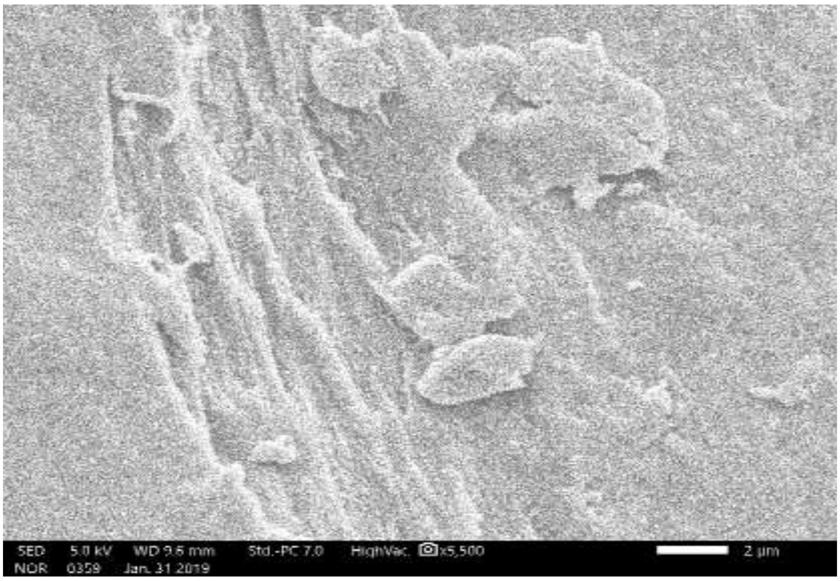


Figure.4.a. At range of 5µm



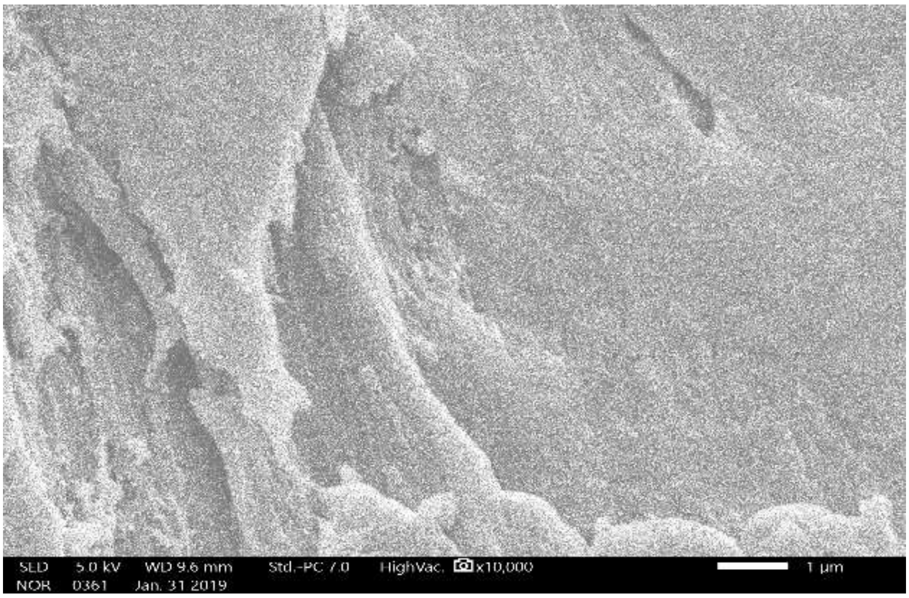


Figure.4.b. At range of 1µm

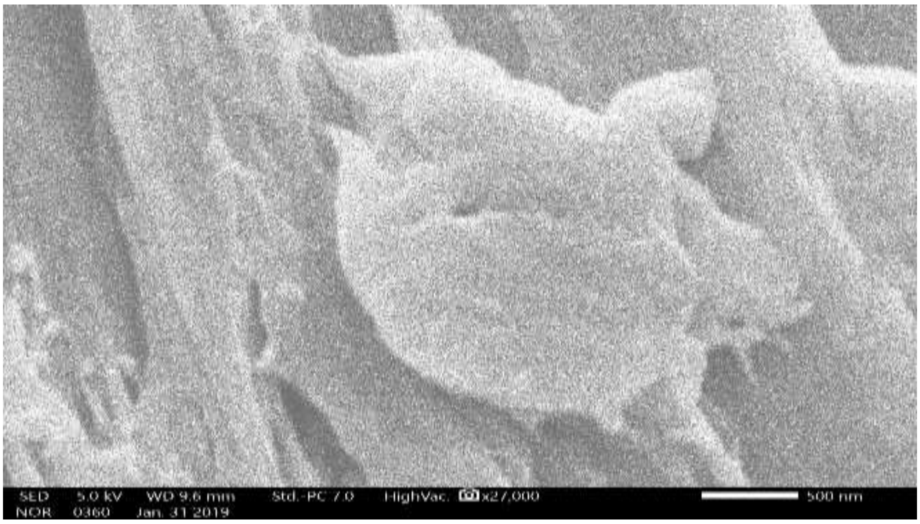
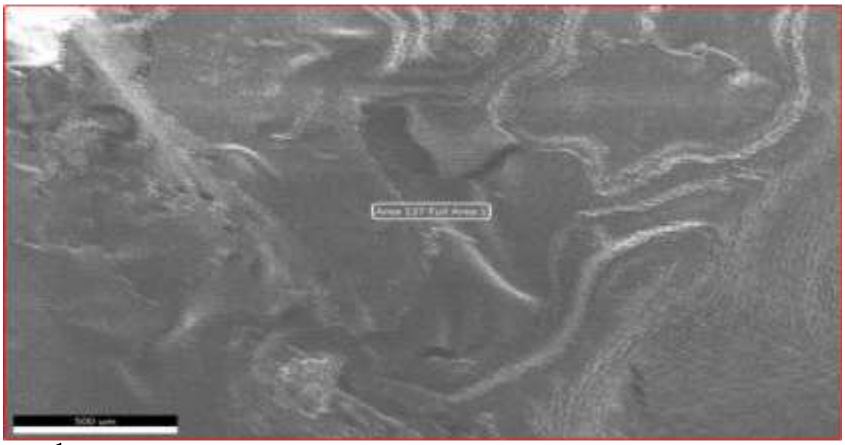


Figure.4.b. At range of 500nm

3.2 <u>EDXA RESULTS</u>:

Figure.5 shows composition results obtained at full Area1shown in figure.6 in the form of graph and Table.1 shows the composite content present in the prepared nanocomposite material such as metals &gases. The composite proposition of a carbon is in greater amounts (about), chlorine, sodium as impurities in a lesser amount (about) and oxygen (about).



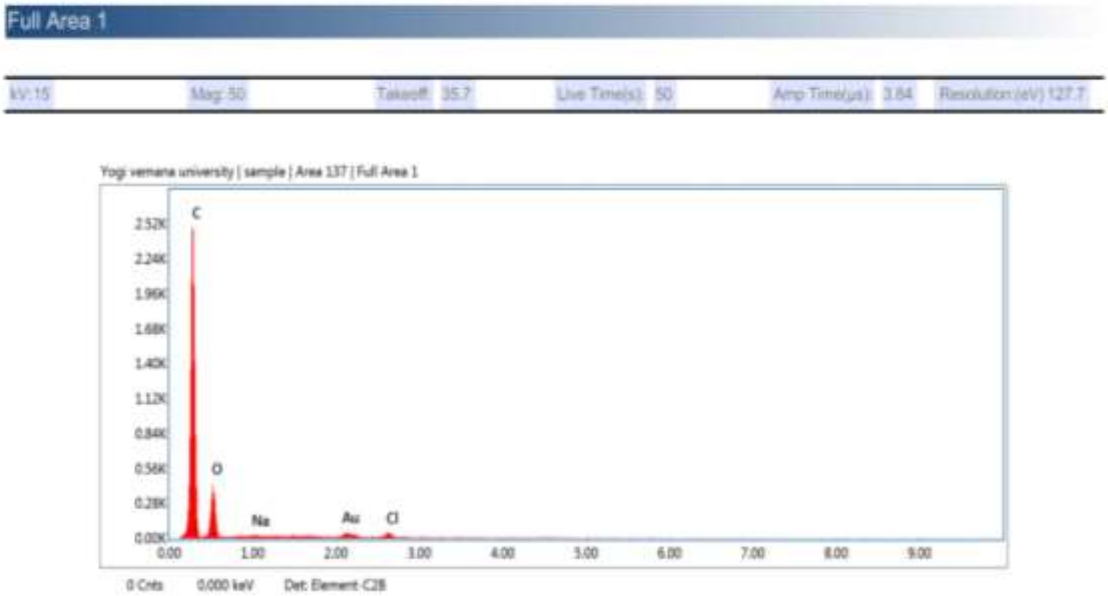


Fig.6 Smart Quant Results

Table. 1 Smart Quant Results

Element	Weight %	Atomic %	Net Int
C k	68.49	79.24	295.3
O k	27.06	22.62	54.89
Na k	0.77	0.45	3.49
Au m	2.24	0.15	6.15
Cl k	1.44	0.54	7.89

4. CONCLUSION

Hence the structure of ABS/Graphene has been analysed with SEM including EDXA. The composite consisting of following compositions

C k	**68.49**	**79.24**	**295.3**
O k	27.06	22.62	54.89
Na k	0.77	0.45	3.49
Au m	2.24	0.15	6.15
Cl k	1.44	0.54	7.89

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