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SYNTHESIS AND CHARACTERIZATION OF LDPE/$NiFe_2O_4$ NANOCOMPOSITES FILMS FOR MECHANICAL PROPERTIES AND FTIR FOR STRUCTURAL ANALYSIS.

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Abstract : Synthesis of Nickel Ferrite, a low-temperature combustion path is used by adding a fossil fuel of 2.360 grams of Nickel Nitrate and Ferrous Nitrate was taken in a ceramic crucible and 15 ml of organic fuel was poured into the crucible and mixed homogeneously. The prepared mixture was put into the preheated muffler furnace, which was kept at 400 0C. In this case, a combustion reaction occurs between metallic nitrates and fuel, producing Nano powders of $NiFe_2O_4$.The nanocomposite LDPE thin films were synthesized by dissolving $NiFe_2O_4$ NPS of desired quantity for LDPE suspension, and after 60 minutes of ultra-sonication 10 ml of each composition is dispersed in a separate glass petri-dishes. All the films were dried at 70 ° C for 60 minutes and kept at room temperature for 48 hr. This is particularly important because the water remaining in the mixture could cause air bubbles to form in the samples. The average crystallite size of LDPE/$NiFe_2O_4$ Polymer Nanocomposites is found to be 30 nm by XRD, the prepared samples are Characterized for Mechanical properties and FTIR. Pure LDPE had a high tensile strength and very little elongation at break, whereas composites containing additional Nano particles had a greater tensile strength and much more elongation at break than pure LDPE.

Index Terms **– LDPE, XRD, FTIR, $NiFe_2O_4$,**

I. INTRODUCTION

Nano composites, has multiphase where one of the dimension should be in Nano in size. Low Density Polyethylene (LDPE) the polymerization is started by metal catalysts, specifically Ziegler or Philips type catalysts. The genuine polymerization cycle can be carried out in the phase of solution or even in gas phase of reactors. Typically, octane is the co-monomer in the solution phase while butane and hexane copulate with ethylene in the gas phase reactor. LDPE has a tensile strength which is unmatched excellent, puncture resistance, impact strength and flexible. It can be used to make thin films, it is chemically resistant and has strong electrical characteristics.

During last two decades (20 years), organic polymers have been found to have good electrical conductivity. Because of their low specific weight, good resist to corrosion & thrilling possibilities for fabricated plastics in electrical cables, thin films, or electronics equipment, these materials have gotten people's attention of both commercial as well as academicians in the field, from chemistry to solid-state physics and electrochemistry to metabolism. Close contact between scientists of diverse backgrounds has been an important factor in the rapid development of polymer operations. PNCs it is possible to characterized as a composite's in which little amounts of Nano measured filler are dispersed in the polymer network at different weight percentage. The amount of

Nano filler accumulated. in the matrix is very low (less than 10 % by weight). The amount of micro fillers in polymer nano composites, on the other hand, is so high that it can reach 50% or more of the weight of the total mass. Amin, M., & Ali, M. (2015) [1].

The thickness is initiated by polyethylene (LDPE) metal impulses, notably the Ziegler or Phillips type impetus. Actual polymerization process should be possible reactors in either solution or gas phase. Typically, the co-monomer is octane in the solution phase, copolymers of butane and hexane. In a gas phase reactor, with ethylene. Shamiri Ahmad, et al. (2014) [2]. LDPE has high elasticity high impact and puncture resistance. It is really adaptable and pulls it very well under pressure, it can be used to make thin films with better ecological pressure splitting, great protection from engineered mixtures. Is and has many properties. It may be that, it is not simple to process, it sparkles and has a small range for fixing. Polystine is a remarkably undefined. Polymer is very hot and with radiation safe properties, polystyrene is available with many types of aggregates. Stalin can provide properties such as part hardening, flame resistance and solvent resistance. Commercially available polystyrene is mostly eutectic in nature and amorphous. Abdel-Barry Elsid M (2003) [3].

II. SYNTHESIS OF NICKLE FERRITE NANO PARTICLES

Synthesis of $NiFe_2O_4$ NPs from organic fuel, a low-temperature combustion route is used. A 2.360 grams of Nickel Nitrate and Ferrous Nitrate in a crucible made of ceramic and 15 milliliter of fossil fuel was added to the crucible, and uniformly mixed. The prepared chemical's mixture was added to a muffle furnace that had already been preheated to 400°C. Metallic nitrates and fuel are burned together to produce Ni: Fe_2O_4 Nano powders. The chemical process of synthesis is represented as,

$$Ni(NO_3)_2.6H_2O(aq)+2Fe(NO_3)_3.9H_2O(aq)+4C_2H_6N_4O_2(aq)\rightarrow NiFe_2O_4(s)+36H_2O(g)+12N_2(g)+8CO_2(g)$$

III. SYNTHESIS OF NICKLE FERRITE LDPE POLYMER NANO COMPOSITES.

The 0.5 grams of LDPE beads were dissolved in at 70°C with 50 ml cyclooxygenase, pure polyethylene films have been produced, stirring continuously for 120 minutes. To form a pure LDPE film, 10 ml of LDPE suspension was dispersed on a glass Petri plate. The LDPE nanocomposite films were made by dissolving $NiFe_2O_4$ (i.e. 10 wt% –50 wt%) NPS required for LDPE suspension, continuing to follow an hour of ultra-sonication, 10 ml of composition was dispersed in separate glass petri-dishes. Prepared all the films were dried at 70 ° C for 60 min and kept at room temperature for 48 hr. This was particularly important for this entire phase before compression molding because the water remaining in the mixture could cause air bubbles to form in the samples.

IV. CHARACTERIZATION

4.1 XRD of LDPE/$NiFe_2O_4$ NCs Films

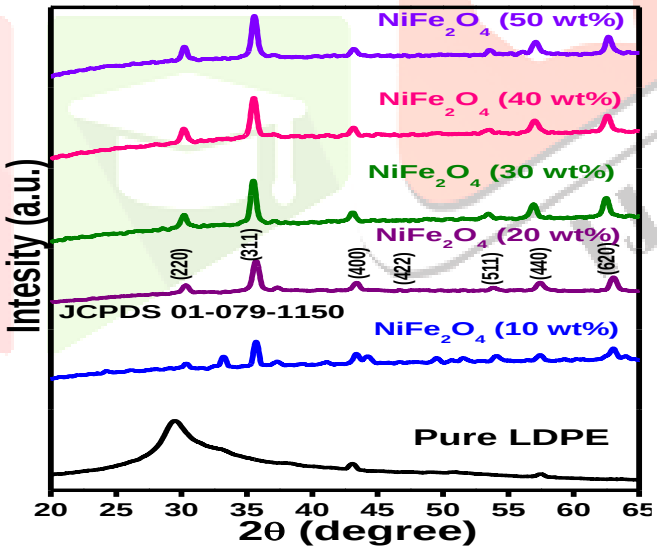

Fig.4.1. XRD of LDPE/$NiFe_2O_4$ NCs Films.

Figure.4.1 shows the XRD peaks of LDPE/NiFe2O4 nanocomposites in different compositions. Pure LDPE shows the broad peak at 260 indicates the amorphous in nature. Nanocomposites shows the 2 theta 30.90,37.240,44.50,54.500,63.200, and 70.20 corresponding to a plane of (220), (311), (400), (422), (511), (440), and (620) indicates the cubic structure of the nickel oxide retains in the polymer matrix [152-153]. The average crystalli.te size of the NPS is 30 nm.

The Scherer's relation is used to calculate the average crystallite size [18];

$$D=\frac{0.9\lambda}{\beta\cos\theta} \qquad (1)$$

NiF_2O_4 (wt %)	Crystallite size (nm)
10	24
20	30
30	26
40	20
50	18

Table.4.1 The estimated average crystallite size LDPE/NiF_2O4 (10-50 wt %) NCs.

4.2 Mechanical studies of Pure LDPE Films

The open volume between polymeric chains can be increased by using LDPE polymer films. As a result, there is a clear peak for higher load as it increases the more load, as seen in graph 4.13 due to closed pack of atoms. The plasticizer is a chemical that is used to make plastic and added to products to impart stability, workability, and elongation. The plasticizer in the thin films is used to combat the brittlenes's of the thin film caused by the large intermolecular forces [5]- [6]. The graphs below demonstrate the stress–strain relationship of LDPE prepared new ductile materials. which is very less compared to all doped LDPE, so doping process enhance the mechanical strength of the materials.

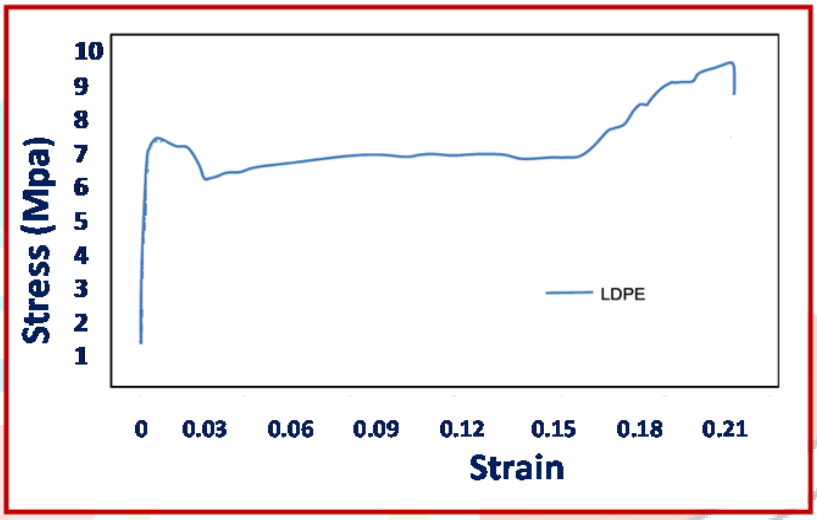

Fig.4.2 Mechanical studies of pure LDPE

Name of sample	Stress (MPa)	Strain	Y (MPa)	Poission ratio
LDPE	6.80	0.24	8.20	0.32

Table.4.2 Different values of mechanical properties of LDPE

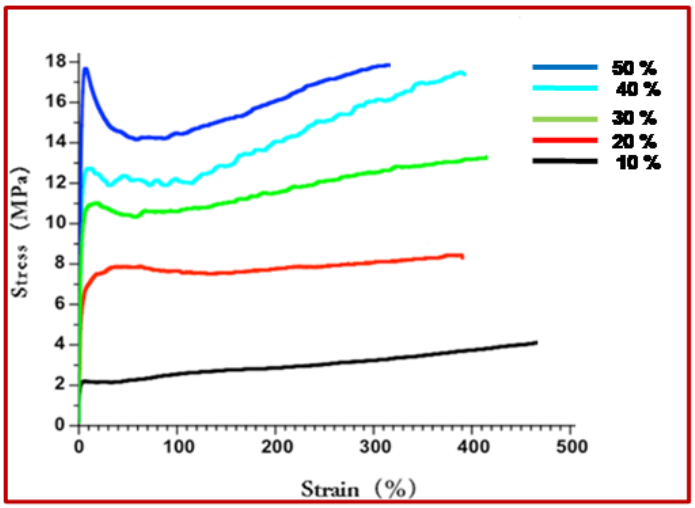

Fig.4.3 Mechanical studies of LDPE/$NiFe_2O_4$ NCs Films

Name of sample	Stress (MPa)	Strain	Y (MPa)	Poission ratio
LDPE/ $NiFe_2O_4$ 10 wt%	6.90	0.18	6.20	0.14
LDPE/ $NiFe_2O_4$ 30 wt%	10.2	0.19	9.42	0.130
LDPE/ $NiFe_2O_4$ 50 wt%	13.2	0.22	12.15	0.134

Table.4.3 Different values of mechanical properties of LDPE / $NiFe_2O_4$ (10,30 & 50 wt.%)

4.3 FTIR Spectra of LDPE/$NiFe_2O_4$ NCs Films

The FTIR spectra of the pure and mixed Nano ferrite polymer composits is shown in Figure 4.11. Due to the p.resence of quinoid & the intense peaks at 570 cm-1 may attributed the ring of benzenoid stretching (Ni=O=Fe), 1370 cm-1 is due to the C-O-C deformation of the molecules,1200 and 1570 cm-1 due to C-H stretching of excess oxidant, similar nature observed by reaming all the samples i.e. 10 wt %, and 20 wt % of nano films. Due to the weak Vander Waals power, the absorption frequencies are marginally changed to the lower side of the spectrum.

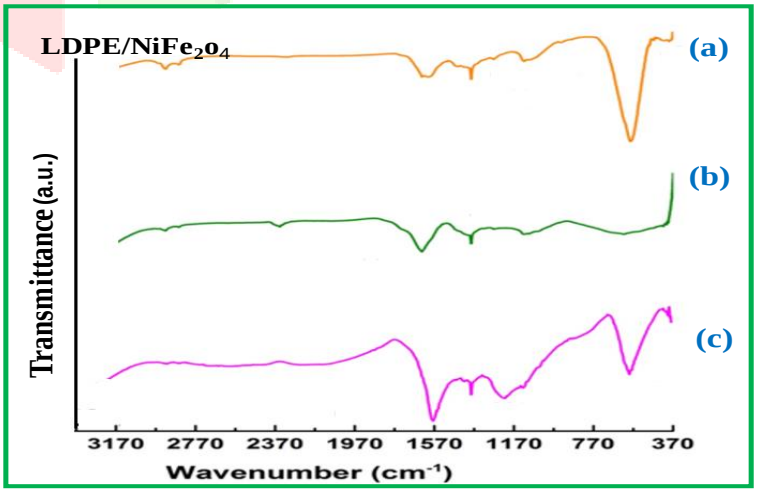

Fig. 4.4 FTIR Spectra of LDPE/$NiFe_2O_4$ NCs Films

Sl.No.	Wave number (cm^{-1})	Assigned Peaks
1	570	Metal-O-Metal(bridging-O between Ni and Fe)
2	1373	C-O –C vibration
3	1570	C-H Stretching

Table.4.4 Band assignments of FTIR Spectra of LDPE/$NiFe_2O_4$ NCs Films

V. CONCLUSION

The structural study of the LDPE was known by the XRD diffraction pattern which clearly indicates the amorphous nature of the pure LDPE and the amorphous nature of the sample is converted to semi-crystalline nature when it is doped with nanomaterials and average crystallite size of nao particles is found to be 30nm. The composites' mechanical characteristics were studied utilizing the universal testing machine. The addition of nanoparticles in the composition showed very good mechanical properties. Pure LDPE has higher tensile strength and lower elongation at break, LDPE-containing composites with additional nanoparticles exhibit higher tensile strength than pure LDPE and greater elongation than pure LDPE. Finished composites have very good mechanical ductility and dimensional stability which make them good candidates for complex structure and coatings preparation. The FTIR spectra of the pure LDPE and mixed Nickle ferrite polymer composites shows the presence of quinoid & the intense peaks at 570 cm^{-1} may attributed the ring of benzenoid stretching (Ni=O=Fe), 1370 cm^{-1} is due to the C-O-C deformation of the molecules,1200 cm^{-1} and 1570 cm^{-1} due to C-H stretching of excess oxidant.

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