THE EFFECT OF AMOUNT OF GRAPHENE FOR THE STUDY OF BARRIER PROPERTIES OF EPOXY-GRAPHENE NANO COMPOSITES

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ABSTRACT

The vapor barrier film of epoxy graphene nanocomposites of 0.75 and1.5wt% was synthesized by dispersion method this dispersion of graphene mainly attributes to the excellent water barrier property. when epoxy combined with graphene nanoparticles show significantly increased toughness and dampness capacity of epoxy system this is mainly due to free volume reduction respect to the pristine polymer The nanocomposites derived from graphene show excellent electrical ,thermal and mechanical properties. The excellent electron transport ,high surface area and mechanical properties of graphene epoxy nanocomposites has potential applications in food packaging, anticorrosive coating The synthesized the barrier film of epoxy graphene composites were characterized by differential scanning calorimetric techniques (DSC) The barrier properties were investigated by using electrochemical impedance spectroscopy (EIS).

Key words- Epoxy nanocomposites , barrier properties graphene nanoparticles

Materials & Method

Graphene nano particles used in this work are made of few layers with width of

water borne resin without corrosion inhibitors. It contained additives such as emulsifying and dispersing agents and surfactants mainly 63% weight of solid TiO_2.

Nomenclature used to identify the different specimens.

Plain epoxy system	Epx
Loading with 0.75% wt. of graphene	Epgo.75
Loading with containing 1.5% wt. of graphene	Epgo1.5

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In order to evaluate the effect of the nano piller on the epoxy matrix properties, a thermal analysis was carried out taking 10 mg of the sample. Three scans (heating, cooling and heating again) were carried out from 30-250 ^0C with a heating rate of 10 ^0C per minute for each specimen.

Results and Discussion

The measured water contact angle (see Table 2) of the unfilled epoxy system s about 66,3 °; when the rnanoparticle are dispersed in the epoxy resin, the contact angle increased to 88.1(Epg0.75sample) and 102.1(Epg1.5sample).The increase in the contactangle is mainly due to the increase in amount of graphene nanoparticle which in turn increase the hydrophicity of the epoxy graphene nanocomposites leading to the reduction of sorption of water with the films

Sample	Epx	Epg0.75	Epg1.5
Water contact angle (degree)	66.6	88.1	102.3

When exposed to the 3.5%wt of aerated NaCl aqueous solution the epoxy graphene nanocomposites films show increase in the impedance modulus when campared to no loaded epoxy system which indicates better barrier properties Even after one day exposure to the test solution at low frequency is slightly less than 10^7 Ωcm^2

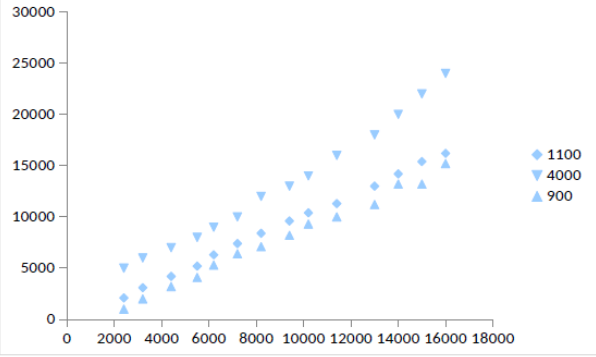
The increase in impedance modulus at low frequency was mainly due to the formation of local anodic

area for prolonged exposure of nanocomposite surface up to 21days this was mainly attributed to the sorption of water and electrolyte which in turn shift impedance modulus at low frequency

The subsequent shift of phase angle at high frequency as function of immersion time is also constituent with further degradation of nanocomposite films. The increase in phase angle of 90^{O}C with minimum (3degrees) is observed at frequency of about 0.44HZ after exposure of one day to test solution

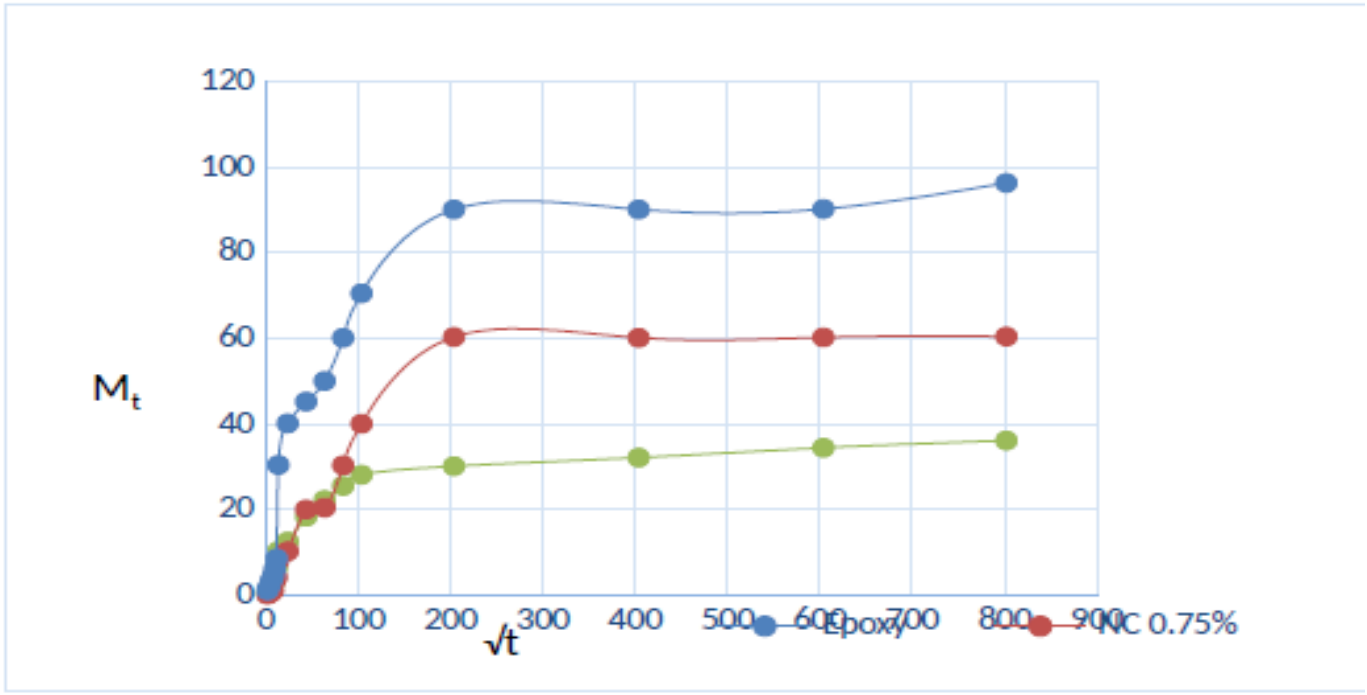
The increase in impedance modulus with the time show better stability of loaded epoxy nanocomposites, The lower value of impedance modulus after one day immersion for neat epoxy system accounts for poor barrier properties when compared to graphene loaded epoxy nanocomoposites which shows continously slightly increased values of impedance modulus up to 21 days

The increase in impedance modulus (8× 10^7 Ω cm^2), value for Egs1.5 as function of immersion time show better barrier properties of epoxy graphene nanocmposites The compact behavior of epoxy graphene nanocomposites was explained on the basis of no full penetration of the electrolyte in the given time interval



Meaningful impedance related to the effect of graphene on the Barrier properties of the epoxy naocmposites is evaluated at 0.02 Hz are reported. As can be seen from this figure, the filled nanocomposites exhibited impedance modulus greater than the unfilled base epoxy for all exposure times showing the noticeable effect due to the use of graphene. In addition, EG1.5 showed an impedance modulus of one order of magnitude greater than that exhibited by the base epoxy for all exposure times.

The water diffusion coefficients through epoxy nanocmposites is calculated from the initial slope of the curve of mass sorbed vs square root of time these water diffusion coefficients of Egs 1.5wt%of graphene to the epoxy system are lower than those exhibited by the Egs0.75



The increased performances of epoxy graphene nanocomposites to the barrier effect was mainly due to graphene which induces a decreased. water diffusivity The effect of amount graphene increase the pathway length of water through which other nanoparticles used as a filler..

After the first 4 days of immersion the nanocomposite, show a slight increase, , day by day, to the end of immersion time, reaching a steady value, indicating a different water absorption process The observed behavior of the nanofilled epoxy can be attributed to a diffusion mechanism of water adsorption and transport through the nanocomposites

Conclusion

In this work,.The addition of nanoparticles to epoxy sysyem led to a slight increase of the hydrophobic character of the nanocopomosites. The collected EIS data showed that loaded coatings exhibit improved barrier properties which was attributed diffusion mechanism of water transport through the filled epoxy nanocomposites

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