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A REVIEW: THERMAL, OPTICAL AND MORPHOLOGICAL EFFECT OF VARIOUS NANOPARTICLES ON POLY (1,4-PHENYLENE ETHER ETHER SULFONE)

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ABSTRACT Poly(1,4-phenylene ether ether sulfone) (PEES) is an advanced aromatic engineering thermoplastic which has gained considerable interest because of its high thermal stability, mechanical strength, chemical resistance and durability. This review gives a complete picture of the synthesis approaches, structural features PEES-based nano materials. The effects of molecular structure, processing conditions, and chemical modifications on thermal, mechanical, electrical and barrier properties of PEES are described in detail.

KEYWORDS : Poly(1,4-phenylene Ether Ether Sulfone), (PEES), Aromatic Polymers Nanocomposites, Membrane Materials

INTRODUCTION

Polymer Poly(1,4-phenylene ether ether sulfone), its made placed between various high performance-engineering polymers. It is well known for having excellent film forming properties, high thermal resistance and also its stability under acidic conditions [1-2]. Therefore, sulfonated PEES (SPEES) is a potential material for polymer electrolyte membranes in fuel cells. Poly(1,4-phenylene ether-ether-sulfone) is a thermoset polymer hardly used in membrane synthesis till last decades because of its hydrophobic characteristics and it is easy to form a dense membrane for gas separation using modification [3-4]. The fastest growing technology having high separation efficiency using less energy and considering the cost of process the membrane separation technology was found to be preferable one [5-6].

Sulfonation is a useful method for the modification of polymers to introduce sulfonic acid functionality, which aids in the transport of protons. Sufonic group makes the polymer hydrophilic and hence increases the solubility of polymers. Introduction the Sulfonate group in hydrocarbon polymers is a very effective method for the production of proton-exchange, or ion containing membranes for advanced technologies such as electrodialysis and polymer fuel cells [7-8]. The sulfonation of hydrocarbon polymers for functionalization bearing HSO_3 groups is the most suitable method to produce hydrophilic polymers and thereby membranes.

There are several methods of sulfonation explained in the literature [9-11]. These include sulfonation by concentrated sulfuric acid, by chlorosulfonic acid, by pure or complexed sulfur trioxide, and by acetyl sulfate.

Sulfonation of polymers can be done successfully by two basic routes, i.e., via copolymerization of sulfonated monomers or post-sulfonation of polymers [12]. Sulfonated poly(arylene ether sulfone) (PAES) were obtained by copolymerization of sulfonated monomers [13-15]. There are few disadvantages of post-sulfonation of PAES such as poor control of sulfonation reaction due to high sulfonation rates and some undesired side reactions such as chain scission, cross-linking etc.[2, 16] Bunn and Rose in 1992 has done sulfonation of blends of poly(ether sulfone) and poly(ether ether sulfone) by using conc. H_2SO_4 at room temperature and they find that sulfonation of PEES was completed quite rapidly[17].

Due to the presence of aromatic and ether linkages in the polymer backbone, it is provides the necessary strength, molecular rigidity and good processability [18-19]. After seen these all problems, researcher start to focus on the sulfonation of PEES without any significant polymer degradation and obtain SPEES membranes having optimum properties for use as PEM in fuel cells. The Sulfonation is effected by the reaction conditions i.e. reaction time and temperature on the degree of Sulfonation [2].

Effect of various nano-particles:

Nano clay:

Clays have many broad industrial applications as fillers and extenders. When clays blend with the less hydrophilic organic polymers it is often necessary to make the surfaces hydrophobic or appropriately organophilic. This can be achieved in a simple way by binding a suitable organic compound to the mineral surface, such as by neutralizing the acid-washed clay with an organic base which is held to the surface by ion exchange, or by replacing the exchangeable inorganic cations with organic cations or polycations e.g., Rubber where Strong polymer-filler interactions is strongly enhanced.

Polymer nano clay composite properties are directly depends on the polymer matrix properties, the interaction between polymer matrix and nano filler, properties of nano fillers and their surface free energy and surface area of the interfacial bonds. The aspect ratio of the dispersed nano fillers in polymer matrix and the loading level of nano filler define the area of interfacial bond. Even at very low nanoclay loadings, it has shown higher moduli and good thermal properties. Nanoclay is improved the thermal and optical properties of SPEES [20].

Nanohydroxyapatite (nHA) :

Nanohydroxyapatite (nHA) has potential application as an orthopedic biomaterial. good interfacial adhesion should be found between polymers and inorganic hydroxyl apatite (HA) with uniform dispersion of HA at the nanolevel in the polymer nanofiber. When such a composite is immersed in simulated body fluid (SBF), biologically active HA layers are formed on the implant due to the ion-exchange reaction between the bioactive implant and the surrounding body fluids which is chemically and crystallographically equivalent to the mineral phase of the bone .

nHA-reinforced polymer material facilitated an enhanced growth of apatite on the surface, resulting in a decrease in the pore sizes in between the nanofibers, the mechanical strength improved of the composite with more elongation compare to bare PPEES nanofiber. From the results, it was found that the incorporation of nHA considerably influenced the stiffness of the composite material [21].

Carbon Nanotubes:

Carbon nanotubes (CNTs) are nanostructures derived from rolled graphene planes and its chemical and physical properties, have been extensively used in field of biomedicine. The properties of CNTs depend on the structure, morphology, diameter, and length of the tubes. Carbon nanotubes are allotropes of carbon that have a nanostructure. The various application of carbon nanotubes to the synthesis of nanowires has been demonstrated. CNTs can be conjugated with various biological molecules including drugs, proteins and nucleic acid to afford various bio-functionalities [22-24].

TiO_2-Nano Particles:

The SPEES-TiO2 membrane was found to have a low hydrophilic nanocomposite membrane that is useful in the process of the construction of the preparation of fat waste. The flux of the permeate obtained and time is calculated Currently Studies report the extra morphology of the SPPEES material and the effects of the addition of TiO_2 nano particle size in membrane formation. TiO2 nano with wide particle it is used as a deterrent. Flux values were obtained and counteracted the excitability of the modified TiO_2 the membrane has been synthesized [4].

Fe_3O_4 nanoparticles:

There are many pure iron oxide phases in the environment, magnetic fields are very popular nanoparticles (MNPs) are nanoscale zero-valent iron (nZVI), Fe_3O_4 and γ-Fe_2O_3. Magnetite (Fe_3O_4) ferromagnetic black color iron oxide for both Fe (II) and Fe (III), which have been widely used [25].

Nanofiltration (NF) can be used in many separation and treatment processes such as water softening, color removal, chemical oxygen demand (COD) reduction and separation of medicines due to separation efficiency, regenerability of the used sorbent of Fe_3O_4 nanoparticles. The concentration of Fe_3O_4 nanoparticles increased membrane performance (PWF, permeability flux and salt rejection) and enhanced the properties of membrane structure (water content, porosity and tensile strength). Iron oxide nanoparticle had the most flux, about 1.82 times more than that of the pristine PEES membrane (M1). In addition, the salt rejection of fabricated nanocomposite membranes filled with iron oxide nanoparticle was 35 times higher than that of the PEES [26].

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