ABSTRACT

High dielectric permittivity materials have widespread applications in various fields like energy storage capacitors, micro capacitors in IC, sensors, printed circuit boards etc. The introduction of high dielectric permittivity materials on the nanoscale into the polymer matrix could increase the dielectric constant of the polymer nanocomposites. For high dielectric applications, the polymer composite should exhibit high dielectric permittivity, low dielectric loss and high breakdown strength. High dielectric permittivity is highly desired for the dielectric materials used in the embedded capacitors and energy storage devices. In order to enhance the dielectric properties of the BMI-epoxy composites, suitable fillers with high dielectric constants are added.

The specific objectives of the research work include

- To develop a new polymer nanocomposite as a substitute for ceramic insulators with enhanced electrical and mechanical properties for high dielectric applications.
- Synthesis of $BaTiO_3$ by hydrothermal method and surface hydroxylated $BaTiO_3$ by using H_2O_2 and their characterisation using SEM, EDAX and FTIR.
- Fabrication of nanocomposite with bismaleimide-epoxy as polymer matrix and $BaTiO_3$, Rochelle salt and surface hydroxylated $BaTiO_3$ as nanofillers for improving the dielectric properties.
- BMI-epoxy nanocomposite reinforced with E glass fiber (EGF) and silane-coated E glass fiber (SC-EGF) fabrication as per ASTM standards for different compositions of nanofillers.
- Morphological study of the synthesised reinforced and non-reinforced composite using SEM and structural analysis using XRD, EDAX and FTIR.
- Evaluation of the effect of different nanofillers and the reinforcement (EGF and SC-EGF) on thermal stability and mechanical properties such as tensile strength and flexural strength.
- Studies on dielectric constant, dielectric loss factor (tan delta) and dielectric breakdown strength of the synthesised composite.

- Analysis of dielectric behaviour, ac conductivity and electromagnetic interference shielding effectiveness (EMI-SE) of the fabricated BMI-epoxy nanocomposites with optimised weight percentages of the nanofiller.
- Effect of MWCNT on thermo-mechanical, electrical and EMI-SE of BMI-epoxy composites with different nanofillers such as BT, RS and BTOH.
- To study the suitability of the synthesised BMI-epoxy nanocomposites in relevant fields.

In the present work, a new class of BMI-epoxy composites separately reinforced with E glass fiber and silane coated E glass fiber were fabricated using a simple hand layup method followed by compression moulding. Further performance enhancements made by the incorporation of a variety of nanofillers such as $BaTiO_3$, Rochelle salt crystals and surface hydroxylated $BaTiO_3$ nanoparticles were studied. In order to improve the ac conductivity and EMI-SE, MWCNT conductive filler is added and further investigation is carried out.