# 에폭시기반 마이크로 그리고 나노입자가 혼합된 콤포지트의 기계적특성

# Mechanical Properties for Micro-and-Nano- Mixture Composites Based Epoxy Resins

권순석, 최보성, 백관현, 이창훈, 박재준
Sun- Suk Kwon, Bo-Sung Choi, Kwan-Hyun Baek,Chang-Hoon Lee, Jae-Jun Park

중부대학교, 전기전자공학과
Department of Electric Electron Engineering, Joongbu University

**Abstract** : Nano particles (10nm SiO2) were silane-treated in order to modify the surface characteristics in a epoxy nanocomposite. Then, micro particles (3μm SiO2) were poured into the epoxy nanocomposite using various mixing process and epoxy/ micro-and-nano- mixed composites (EMNC) were prepared. The thermal (Tg) and mechanical (tensile and flexural strength) properties were measured by DMA and UTM and the data was estimated by Weibull plot.

**Key Words** :

## 1. 서 론

Polymer nano composites include a small amount of nano fillers up to 1~15wt% and contribute to the light weight, compactness, and low cost of facilities and systems and then it will be usefully applied to the next generation molding insulation and all solid insulation substations [1]. Therefore, it can be expected that the use of polymer nano composites as a type of industrial material will be increased in future. In particular, epoxy resins are applied to dry mold transformers and power CT/PT. Also, solid insulated switchgear(SIS) and gas insulated switchgear(GIS) require a large insulation spacer in order to support internal conductors. In general, it is essential for heavy apparatus systems as not only electric rotating machineries but static mold machineries. The epoxy resin is to be filled by certain micro scaled fillers (silica or alumina) in order to obtain low thermal expansion using some conductors, such as aluminum or copper [2]. The mechanical and electric properties of insulation materials at high temperature (about 100'C) determine the performance of these apparatuses and that assure a step further in the realization of environmental friendly heavy apparatuses by using it to solid insulation systems without using SF6 gas .

## 2. 결과 및 토의

It can be considered that the interface was fatally weakened by a loose coupling between the micro filler and the polymer matrices as the micro SiO2 particles were changed to composites by mixing them into epoxy resins. In addition, it can be seen that it directly affects the mobility of polymer chains. As a result, it represents a large increase in the mobility and a significant weakness in the interface caused by the cohesion of particles. Also, if the cohesion between the loose coupling between the nano particles and the matrices and the particles occurred, the crosslinking will be weakened, and the glass transition temperature will also be decreased. Thus, the glass transition temperature decreased due to the concentration of stresses around the cohesive nano fillers . However, in the case of the sample with the Silane processing, although it shows some cohesion due to the strengthening of the coupling force between the surface of nano particles and organic polymer molecular, it disturbs its mobility through constraining the chains of polymer resins by such nano and micro particles due to the improvement in its interface and that leads to improve its mechanical and electrical properties. The crosslinking density is an important factor that controls the glass transition temperature for a normal thermosetting polymer setting system [5].

## 감사의 글

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† 교신저자) 박재준, e-amil: jjpark@joongbu.ac.kr, Tel: 041-750-6751
주소: 충남 금산군 추부면 대학로 101번지 중부대학교 전기전자공학과