전자패키징용 에폭시/이미드 박막의 제조 및 특성분석
(Synthesis and Characterizations of Epoxy/imide film for Electronic Packaging)

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Abstract

Epoxy resins are a versatile group of crosslinked polymers that have excellent chemical resistance, good electrical insulating properties, good adhesion to glass and materials, and can be easily fabricated. The variety of properties helps the epoxy resins to meet the performance requirements of some demanding applications. These include areas as diverse as construction, electronics, adhesives, and coatings. However, The usefulness of epoxy resins for many applications is often limited due to their inherent brittleness resulted from their crosslinked structure.

Polyimides have been widely used as protective overcoats and dielectric layers for semiconductor devices because of their good properties, e.g. excellent thermal stability, high chemical resistance, good mechanical properties, low dielectric constant, and easy processability. There are many studies which have used polyimides in epoxy systems intending mainly to improve the thermal stability and toughness. Almost all of the studies are based on physical blending of unreactive linear polyimides.

In this study, I made another approach to prepare epoxy-polyimide (EP-PI) composites of high thermal stability and good mechanical properties and use soluble reactive polyimide containing hydroxyl functionalities as a hardener. This method has an advantage that the shrinkage during cure encountered with using poly(amic acid) will be avoided. The presence of polyimide is capable of exhibiting flexibility characteristics and noticeable thermal stability as well as being curing agents on their own. An aromatic polyimide containing pendent hydroxyl groups *ortho* to the heterocyclic imide nitrogen was found to rearrange to a 2,2-bis(3,4-dicarboxyphenyl)hexafluoropropane upon heating above 220°C in an inert atmosphere. A hydroxy-containing fully aromatic polyimide film based on 2,2-bis(3,4-dicarboxyphenyl)hexafluoropropane (6FDA) and 2,2-bis(3-amino-4-hydroxyphenyl)-hexafluoropropane (AHHFP) was prepared by thermal curing method and then reacted with Biphenyl epoxy resin. The residual stress behaviors measured on Si (*100*) substrate were analyzed. For Epoxy/Polyimide (EP/PI) films, as the composition of polyimide increased, the residual stress drastically decreased in tension mode. It is considered that residual stress behavior induced between substrate and EP/PI thin film strongly depended upon the morphological structure of EP/PI film. The resulting film was found to be amorphous by wide angle X-ray diffraction (WAXD). The film also showed excellent solvent resistance and good thermal stability by Differential Scanning Calorimeter in nitrogen occurring at 500°C.

With these results, the effect of polyimide segments on these residual stress behaviors might result from some differences in the morphological structures of EP/PI films prepared from different composition.

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