

Study on Polyimides for Electronic Applications

Zong-guang WANG

Research Institute of Polymer Materials

Shanghai Jiao Tong University

Polyimide (PI) is a high performance polymer material. It possesses excellent mechanical property, electrical property, thermal and oxidization stability, and has been widely applied in aeroplane, aerospace, electrical and electronic industry. Since 1970's, PI has been widely applied in electronic industry for (1) surface passivation and as separation layer for LSIC, (2) surface package of semiconductive devices, and (3) alignment film of liquid crystal display (LCD). Shanghai Jiao Tong University has been studying polyimide materials for electronic application since 1979. The main research topics can be concluded as following:

1. Study on the Photo-Etching Technology of Polyimide

An unique method was used to photo-etch polyamic acid film with chemical etching and plasma etching masked with negative photoresist. The film was then converted to polyimide through an thermal imidization process.

2. Study on the Technology of Applying Polyimide as the Insulation Layer in Multiple Layer Circuiting

3. Study on the Microelectronic Feature of Polyimide

TSC and TVS were applied to study the activation energy of the migration of sodium cation in a MPOS (Metal-PI-SiO₂-Si) structure. It was found that PI layer has the ability of binding sodium cation and MPOS structure possesses great anti-sodium ability.

4. Study on the Adhesion Property of PI/SiO₂

Several surface analysis techniques were utilized to study the adhesion property of PI/SiO₂ interface. It was found the a silicon-containing polyimide possesses greater adhesion with SiO₂ surface due to the generation of chemical bond with SiO₂ after a thermal treatment.

5. Study on the Anti-Decomposition Property of Polyamic Acid Solution

It was observed that if the carboxylic acid group in polyamic acid was terminated, the anti-decomposition property (room temperature storage stability) of a polyamic acid solution can be much improved.

6. Study on the Soluble Polyimide

Several series of soluble polyimides were synthesized using flexible monomers and co-condensation technology. Their properties were measured and some close relationships between structure and property were observed.

7. Development of Photosensitive Polyimides

Photosensitive polyimides were prepared by grafting photosensitive groups to polyamic acid. Self-photosensitive polyimides were also obtained by using non-photosensitive monomers.

8. Development of High Pretilt Angle Polyimides Used as Alignment Film in LCD

High pretilt angle polyimides are being developed by introducing long saturated hydrocarbon chains to the structure of polyimide.

9. Development of Polyimide Monomers

To develop polyimides with high property and multiple-functionality, the study on the synthesis of polyimide monomers has been continuously carried out for more than a decade.

The study on polyimides for electronic application will be continued. In addition, new applications of polyimide are being studied:

1. Polyimide-based thermal stable non-linear optical materials.
2. Polyimide-based micro-meter and nano-meter materials.
3. Polyimide-based permeation film.
4. Application of polyimide material in the manufacture of micro-machine.