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Positive-Type Photosensitive Polyimide Based on a Photobase Generator Containing Oxime-Urethane Groups as a Photosensitive Compound

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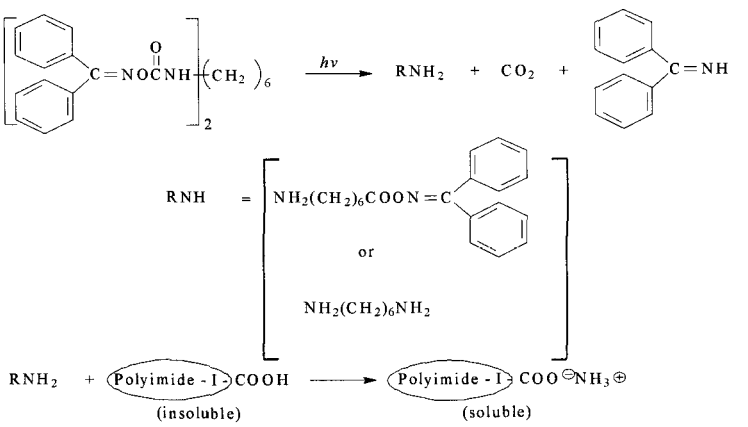
Recently, the application of photosensitive polyimides (PSPIs) in the microelectronic industry is increasingly important since they can be patterned by direct exposure and developed without the use of photoresist. In addition, PSPIs are expected to play an important role in the manufacturing of electro-optic devices such as optical memory matrices, waveguide and non-linear optical materials, and flexible display devices - where higher thermal stability, better processability, and good chemical resistance are required. In this study, a new type of positive-type PSPI, based on a photobase generator containing oxime-urethane groups, is reported.

A semi-aromatic polyimide-I, prepared by the chemical imidation of cyclopentane-tetracarboxylic dianhydride and 2,2-bis(4-aminophenyl)hexafluoropropane, was used for the preparation of a PSPI through the addition of benzophenone and benzophenoneoxime hexamethylene diurethane (HMDU), a photobase generator containing oxime-urethane groups. The chemically imidized polyimide-I film containing benzophenone and HMDU was not soluble in 0.2 wt% tetrabutylammonium hydroxide solution, but it became soluble upon irradiation with 310 nm UV light. A positive tone image with a resolution of 2 μm was obtained with polyimide-I film, having sensitivity (D_c) of 1.2 J/cm^2 and contrast (γ_p) of 1.08, respectively.

The present study demonstrates that a chemically imidized polyimide film, which is not intrinsically photosensitive, can become photosensitive through the addition of a photobase generator containing oxime-urethane groups. It is very likely that amine, which was produced by the photodecomposition of a photobase generator, reacts with the pendant -COOH groups of the chemically imidized polyimide to form carboxylic acid – amine salts inducing solubility increase in a developing solvent. The function of the photobase generator in this PSPI seems to be in analogy with that of naphthoquinone azide in novolak photoresist system.

Scheme 2.



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