Photo-reaction of Polyimide and Practical Application for Photo Sensitive Polyimide

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1. Introduction

Almost 50 years has been passed since Sroog reported polyimide(1). Polyimide is widely used for aero-space, flexible circuit board, insulator for LSI and so on. Recently photo imagable polyimides are desired for micro-electronics applications. To meet those requirements photo-sensitive polyimide coating is developed and widely used for buffer coating and inter-layer dielectrics for electronic devices. Photo-definable polyimide coatings are very useful to simplify the polyimide patterning process and to obtain fine pattern resolution with high accuracy. Especially, positive photo definable polyimide (posi-PSPI) becomes popular due to its alkaline developability, and fine pattern capability.

2. Photo-reaction of Polyimide

Polyimide is composed of tetracarboxylic acid and diamine. The tetracarboxylic acid has electron withdrawing nature. On the contrary, the diamine has electron donating nature. So polyimide forms charge transfer complex not only in the polyimide chain but inter layers. Photo-reaction related with charge transfer complex is expected in polyimides. Frank et. al., and Horie et. al. studied the fluorescence from the charge transfer complex of polyimides(2,3). The fluorescence can be used as monitor of imidization. One fluorescence intensity is depend on the distance between 2 polyimide chains. So the fluorescence is derived from the intermolecular charge transfer complex.

From the point of electro-chemistry, anion radical of pyromeritic dihydride was reported (4). We studied the photo-reaction of ionic bonded photo-sensitive polyimide, found that photo-charge separation was initial reaction (5). In addition, we found that photo-charge separation from soluble rigid polyimides (6). In addition, we found the solution viscosity was decreased when anion radical was formed. The viscosity change may be related with interaction change due to photo-charge separation. Those photo-chemical nature of polyimides is quite interesting and it should be useful for development of photo-sensitive polyimide.

3. Photo-sensitive Polyimide

One of the most useful applications for photo-reaction of polyimides is photo-sensitive polyimide. There are many types of photo-sensitive polyimides were reported (7). We will continue to develop new photo-sensitive polyimides to meet microelectronics requirements. To develop ideal photo-sensitive polyimides, comprehensive understanding of photo-chemical properties of
polyimides is indispensable.

References