

Characterization of UV Curing Polymers by Photochemical Reaction DSC System

Nobuaki Okubo¹, Alexander Rumyantsev²

¹ SII NanoTechnology Inc., ² Labtest

Introduction

Ultraviolet curing polymers are used in wide number of fields such as general electronics, optical electronics, medical fields, glass arts, and architecture. Curing reaction heat when the UV is irradiated can be measured real-time by using Photochemical Reaction DSC System.

In this study, the analysis result of Photoresist and UV curing adhesive is reported as an analytical example using Photochemical Reaction DSC System. The UV irradiation condition dependence of wavelength, irradiation intensity, or temperature against exothermic reaction heat, rate of reaction, or reaction time during UV irradiation is observed.

Experiment

Materials

Sample 1: Photoresist

Dry film of Photoresist is composed several components, including an acrylic monomer that hardens through a polymerization, a binder polymer to form the film, a light-curing initiator and other additives.

Sample 2: UV Curing Adhesive

The sample is a single-component anaerobic 10-second curing type UV curing adhesive.

Instruments

High Sensitivity Differential Scanning Calorimeter

DSC7020

UV Irradiation Unit

for Photochemical Reaction DSC Measurement

PDC-7

SII NanoTechnology Inc.

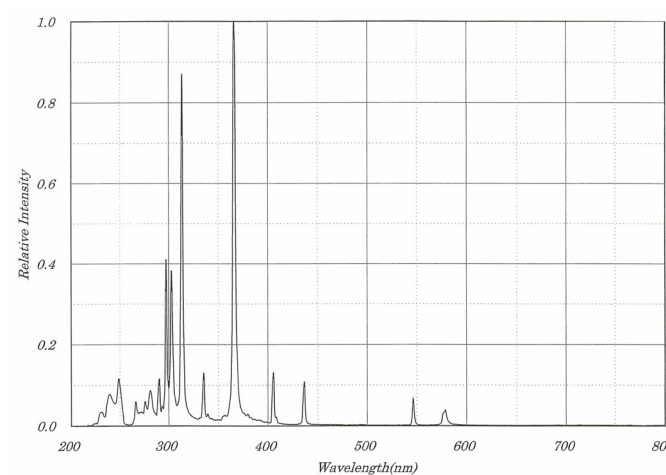


Fig.1 Spectral distribution for UV Spot Light Source

Reflector: 254nm type

Lamp: Hg – Xe Lamp (Quartz type)

Light guide: Quartz Fiber ϕ 5, 1m type

Results

Photoresist

Photoresist provides high resolution and can be used in microfabrication. Furthermore, it can be used to form etching-resistant thin-film in a short period of time. Due to these features, it is used in a wide number of areas, including printed circuit board wiring, electronic parts manufacturing and print plate-making. However, it is known that conditions during light curing, including exposure wavelength, irradiation intensity and reaction temperature, change the formation of etching-resistant thin-film. Therefore, it is necessary to consider various curing conditions when attempting to form the optimal etch-resistant thin-film.

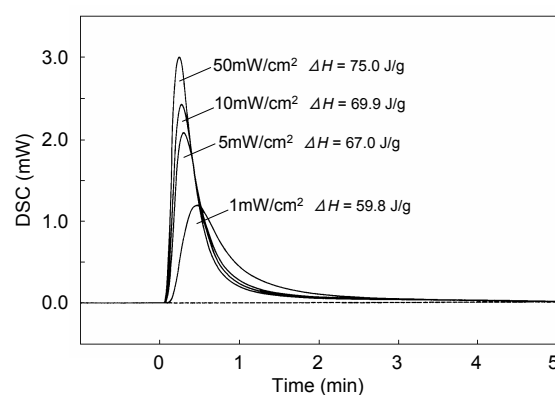


Fig.2 DSC curves for dry film at different irradiation intensities
Irradiation wavelength: 365 nm
Measurement temperature: 25 °C

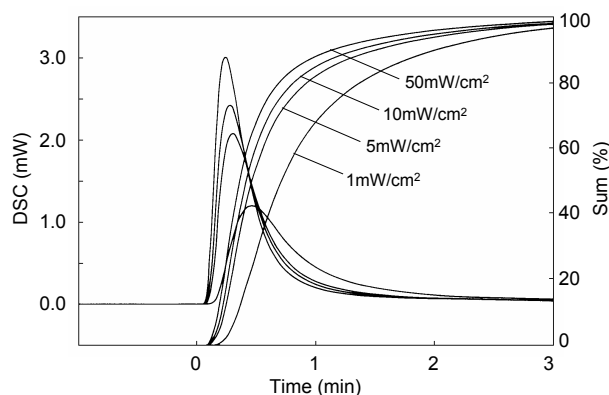


Fig.3 Integral curves of different irradiation intensities
Irradiation wavelength: 365 nm
Measurement temperature: 25 °C

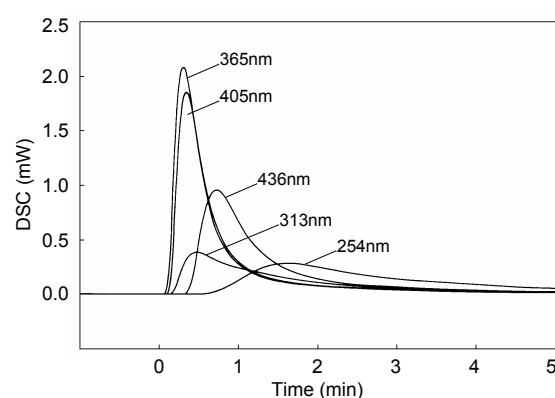


Fig.4 DSC curves for dry film at different irradiation wavelengths
Irradiation wavelength: 5 mW/cm²
Measurement temperature: 25 °C

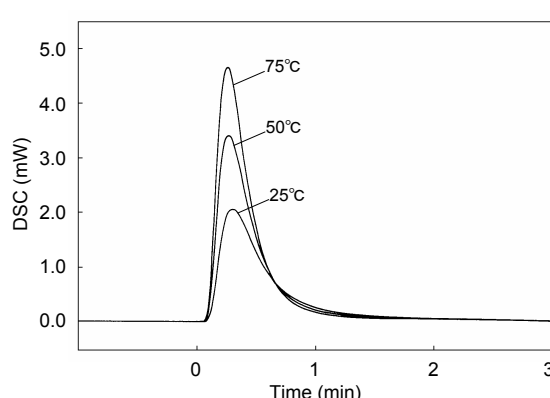


Fig.5 DSC curves for dry film at different measurement temperature
Irradiation wavelength: 365 nm
Irradiation wavelength: 5 mW/cm²

UV Curing Adhesive

The sample is the commercially available UV cure adhesive. Due to the fact it is good to adhere the plastics, it is used to fix and seal the LDC panel, the PCB, and the flexible wirings. In case of UV cure adhesive, a variety of parameters has to be explored to achieve the optimized adhesive quality.

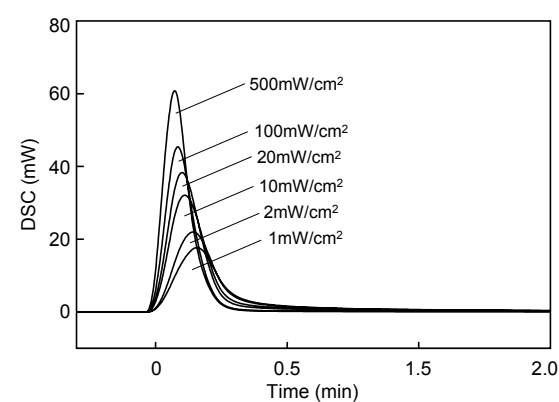


Fig.6 DSC curves for UV Curing Adhesive at different irradiation intensities
Irradiation wavelength: 365 nm
Measurement temperature: 30 °C

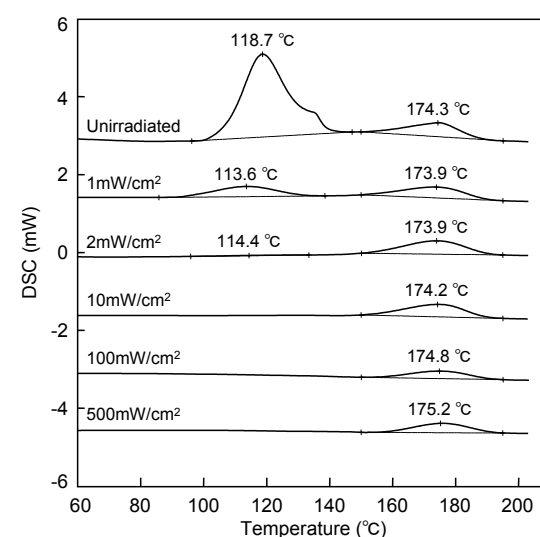


Fig.7 DSC curves for UV Curing Adhesive after measurements of Figure 5 by heating measurements
Sample weight: 2 mg
Heating rate: 10 °C/min