1. Introduction

Demand of highly efficient processor has been increased recently, with increasing especially various high-performance mobile devices. High-performance chip can be achieved by stacking thin die three-dimensionally and this method is called 3D multi-chip packaging.

Wafer has been gradually large-diameter and thinner due to need of consumer who uses mobile devices. Thin die is produced from thinned wafer therefore thinned wafer handling without defect is very important issue. Adhesive is necessary to handle wafer. Device wafer bonded to carrier wafer by adhesive for thinning, chemical mechanical polishing (CMP), plasma enhanced chemical vapor deposition (PECVD) process, and so on. Then device wafer should be finally debonded cleanly from carrier wafer without any residue.

Adhesives for temporary bonding is required to endure stably even at high temperature around 300 °C. Device wafer should not be separated from carrier wafer during a series of process as mentioned above paragraph. Adhesion strength and debonding property is important. But thermal stability of adhesive is most important property for temporary bonding process. [1]

High thermal stability can be fulfilled by incorporating tough linkage to polymer structure which consists of adhesive. But too strong linkage might be trouble when device wafer is debonded from carrier wafer because no residue on wafer is needed after debonding process. Consequently, property control is significant point when polymer design is carried out.

In this research, urethane oligomer was synthesized for temporary bonding adhesive and cured by UV, heat or both. Then required property was evaluated.

2. Experiment

Hydroxy-terminated polydimethylsiloxane (PDMS, Shinetsu, Japan) was used as polyol. Isophorone diisocyanate (IPDI, BASF, Germany) was used to form urethane linkage. 2-Hydroxyethyl methacrylate (2-HEMA, Samchun chemical, Republic of Korea) was incorporated to impart acrylic functional group to main chain. Glycidol (Sigma-aldrich, USA) was also incorporated for epoxy functionality. Dibutyltin dilaurate (DBTDL, sigma-aldrich, USA) was catalyst. Dipentaerythritol hexaacrylate (DPHA, Miwon specialty chemical, Republic of Korea) was used as multifunctional acrylate monomer.

Synthesis process was monitored by Fourier transform infrared spectroscopy (FT-IR) as time passed. Thermal property of cured adhesive film was evaluated by thermal gravimetric analysis (TGA, PerkinElmer, USA).

3. Results and Discussion

Urethane oligomer was synthesized in 4-necked
round bottom flask, synthesis process was monitored using FT-IR.

Fig. 1 shows decrease of isocyanate group caused by reaction between isocyanate group of IPDI and hydroxyl group of PDMS and 2-HEMA. Isocyanate group finally disappeared and it means synthesis was done successfully.

Mass decrease related to thermal stability evaluated by TGA was plotted in Fig. 2. Thermal stability can be improved by forming more dense polymer structure as increasing photoinitiator amount because it is difficult to degrade polymer structure. Photoinitiator amount can be one of the factor affecting thermal stability of adhesive. [2]

4. Conclusion

Adhesive is significant role between device wafer and carrier wafer in 3D multi chip package process. Thermal stability should be preferentially considered for adhesive to be used in wafer processing process and can be regulated by several factor like amount of certain material or linkage incorporation to polymer backbone. Imide linkage incorporation also will be carried out to improve thermal stability of adhesive.

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References
