THE GLASS TRANSITION IN POLYIMIDE FILMS USED FOR MICROELECTRONIC PACKAGING

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Thin polyimide films are commonly used as interlayer dielectric and for microelectronic packaging. New materials with low curing temperatures were developed in recent years to address the demand for low processing temperatures due to the increased complexity of material combinations in today's advanced packaging technologies.

We report on the glass transition temperature T_g of thin films made from photosensitive low-temperature cure ester-type polyimide, and analyze the effect of different curing temperatures T_{cure} on T_g as well as on the thermal expansion $\alpha(T) = \partial d(T)/\partial T$ by temperature-dependent spectroscopic ellipsometry [1]. We found considerably lower T_g in the bulk than in the thin film, and the T_g values of the films increased about 34 °C with increasing curing temperature in the range of T_{cure} = 230 – 380 °C.

These observations are attributed to the temperature sensitive release of the imidization by product 2-hydroxyethyl methacrylate (HEMA) and crosslinker components as well as decomposition products from the material [2,3].

Ellipsometric data evaluation was adapted to account for the release of low molecular weight compounds during the heating process and to model the T_g of the thin films more precisely.

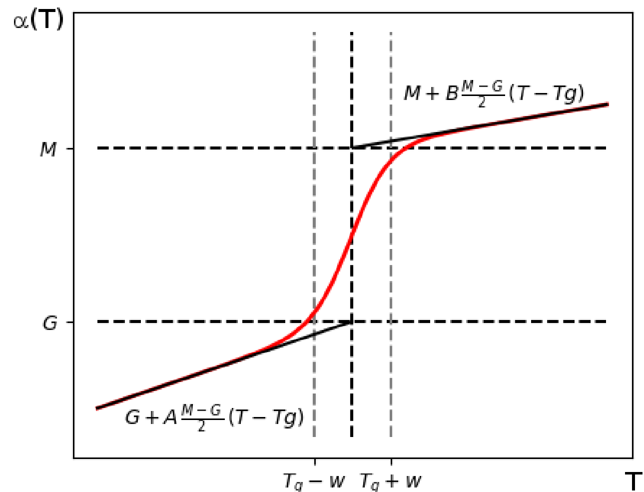

Fig. 1: Sketch to illustrate the trends in the thermal expansion α(T) and the fit parameters *G, M, A, B* as well as the glass transition temperature T_g and the width of transition *w*.

Keywords: T-SE; glass transition temperature; polyimide

References

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