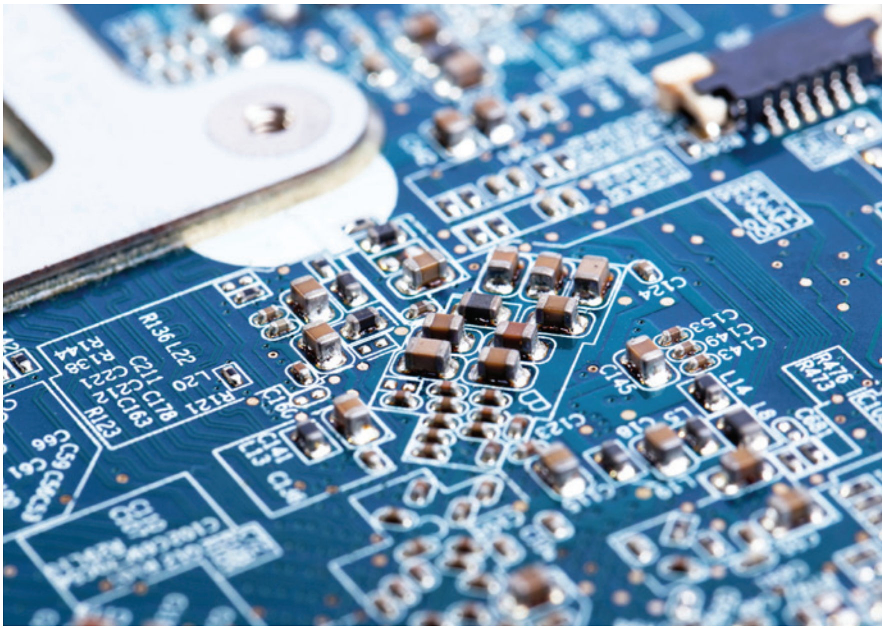

APPLICATION NOTE

Differential Scanning Calorimetry

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Curing of an Optical Adhesive by UV Irradiation in the DSC 8000

Introduction

Optical adhesives are used in many industries where solvents are undesirable. Semiconductors and chip manufacturers for example can not afford solvents depositing on components. Photo-DSC allows fast analysis of the curing profile and measurement of the energy of the curing reactions. Because photo-initiated reactions are fast and energetic, good temperature control and responsiveness are needed to get good data. Power compensated instruments are the best choice for these applications

Experimental

A specialized DSC pan with a quartz cover can be used although an open pan often is acceptable. The sample is heated or cooled to the isothermal temperature and allowed to equilibrate. Pyris™ software allows triggering the shutter of the light source to open and close for irradiation of the sample. Data can be collected at various intensities and times to develop the best cure cycle for the material.

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Figure 1. **DSC 8000.** The DSC's high sensitivity and excellent temperature control makes it ideally for demanding applications like photo curing studies.

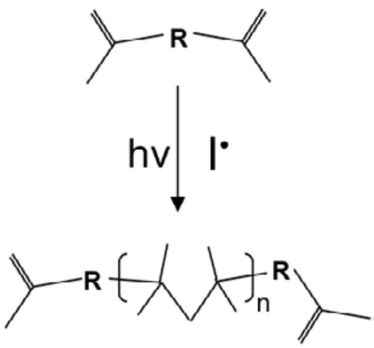

Figure 2. UV curing materials are commonly used as adhesives. UV light generates a free radical which causes the cure.

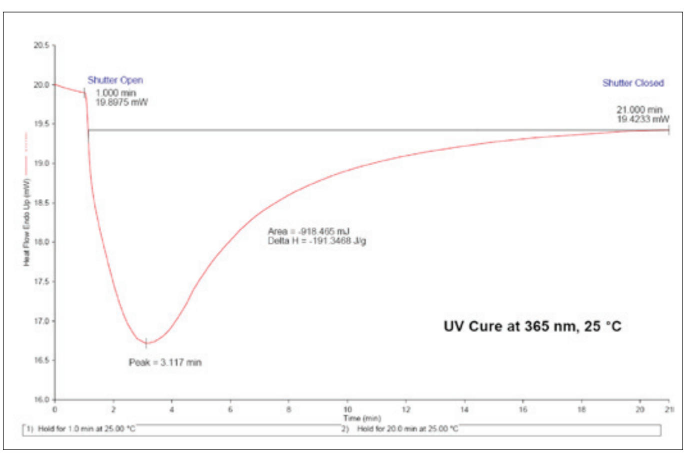

Figure 3. DSC results from the UV driven cure of an adhesive. Light turned on at 3 minutes (red line marked shutter open) for 30 seconds.

The DSC 8000 (Figure 1) is the ideal choice for these studies because the power compensated design allows the instrument to quickly detect and respond to the optical material. The design allows us to maintain a true isothermal through the cure so the sample temperature does not increase. All of the recorded energy therefore comes from the reaction shown in Figure 2.

Results

When the UV source is triggered, the sample is exposed to the UV light. A curing exotherm develops as the material undergoes polymerization. The energy in this peak can be used to calculate the kinetics of the curing process. Figure 3 shows an example of this. When the light is applied at 3 minutes for 30 seconds, a exothermic reaction occurs as the material crosslinks and forms a solid. Since the material is its own solvent, no volatiles are lost and contamination of the circuit board is minimized. Looking at the thermogram, one see the maximium of the exotherm occurs very quickly after applying the light, emphasizing the need for fast response. The energy of the reaction is calculated from the area under the peak, which is why the ability to compensate for the heat coming from the UV lamp is important.

Depending on the material, the exposure can be varied in terms of time as well as the number of exposures. Light frequency and intensity can be varied using filters on the UV source. As UV sources generate heat, the DSC's temperature control must be able to compensate for the energy from the lamp.

Conclusion

Photo-DSC is a powerful tool for studying and characterizing optically curing materials. For more information go to http://www.perkinelmer.com.

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