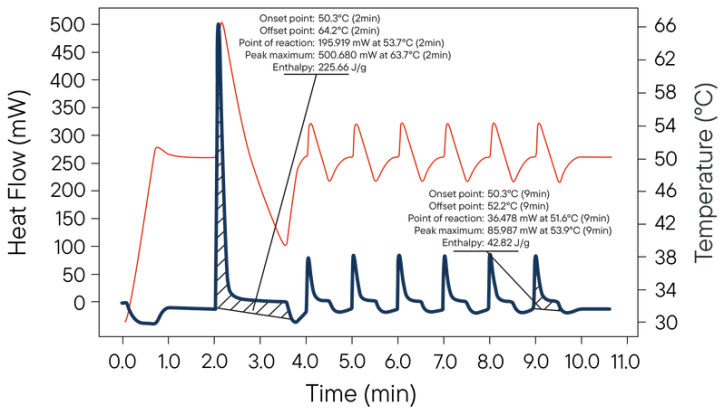
UV Curing Kinetics of Dual-Cure Resin Systems

Photo-DSC Analysis of UV-Induced Polymerization Reactions

Photo-DSC analysis enables the characterization of curing kinetics and reaction enthalpies in UV-curable materials. In this application example, a dual-cure resin system was investigated using the Linseis Chip-DSC L66 Advanced (former designation: Chip-DSC 10) with UV/LED irradiation. The measurement provides valuable insights into curing behavior and process optimization.

Measurement Setup

- Instrument: Linseis Chip-DSC L66 Advanced (former designation: Chip-DSC 10)
- Sample: Dual-cure acrylate/epoxy resin
- Temperature: 50 °C (isothermal)
- Measurement: UV-curing enthalpy and curing kinetics
- Application: UV-curable polymer systems



The Photo-DSC measurement reveals the curing behavior of the investigated UV-curable resin system.

Key observations include:

- Strong reaction peak during the first UV pulse
- Rapid polymerization of the photocurable component
- Significant decrease in reaction enthalpy during subsequent pulses
- Nearly complete UV curing after initial irradiation
- Reliable determination of curing kinetics and conversion behavior

The results demonstrate the effectiveness of Photo-DSC for evaluating curing efficiency and optimizing UV-processing conditions.

Interpretation

The observed curing behavior can be attributed to:

- Fast radical polymerization of the acrylate component
- High photoreactivity of the resin formulation
- Progressive consumption of reactive groups during irradiation

This results in:

- Short curing times
- High conversion rates
- Efficient UV-processing performance

Industrial Relevance

Photo-DSC measurements are widely used for:

- UV-curable coatings
- Adhesive development
- Dental materials
- Additive manufacturing resins
- Process optimization and quality control

Conclusion

The measurements performed with the Linseis Chip-DSC L66 Advanced demonstrate the suitability of Photo-DSC for characterizing fast UV-curing resin systems. The obtained data provide valuable information on curing kinetics, reaction enthalpy and conversion behavior, supporting the development and optimization of advanced UV-curable materials and manufacturing processes.

Source:
Gonzalez, L., Anastasijevic, A., Demleitner, M., Altstädt, V.
Photo-DSC as a Versatile Tool for UV Curing Systems Characterization – From Dental Mass, Adhesives, Coatings and Lacquers to Resins for Additive Manufacturing.
University of Bayreuth & Linseis Messgeräte GmbH.
Adapted from Photo-DSC measurements performed using a Linseis Chip-DSC L66 Advanced (former designation: Chip-DSC 10) with UV/LED irradiation option.