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Dual-Stage Transformable Adhesives: Bridging the Gap between PSAs and Structural Adhesives

A typical pressure-sensitive adhesive (PSA) is a soft, quick-stick bonding tape that delivers convenience and in-line manufacturing efficiencies for final product assembly. Because PSAs offer moderate load bearing ability as compared to liquid or hot melt adhesives, a growing need exists for materials that not only bond and hold substrates together, but also provide additional high-performance benefits demonstrated by structural adhesives.

Adhesives Research (AR) is addressing this need with a dual-stage transformable PSA platform technology. These PSAs incorporate chemistries that are triggered on-demand when exposed to a form of energy such as thermal, radiation (visible light, ultraviolet, electronic beam, etc.), or sound (ultrasonics). This PSA technology reacts very quickly with cure times as short as a few seconds.

Benefits vs. Other Bonding Methods

AR's dual-stage transformable PSAs offer numerous benefits over messy and hazardous liquid or hot-melt adhesive bonding options.

The dual-stage PSAs behave initially as a conventional PSA, offering quick adhesion for bonding substrates without the use of mechanical fasteners for extended periods of time. These PSAs can also be provided in a range of constructions, including single-faced, double-faced, and transfer films, which

can be easily and safely applied by hand or machine. They also contain extremely low to no volatile organic compounds (VOCs).

The dual-stage PSA adhesive exists in two states. In its first state, the PSA forms instant bonds like any other PSA tape product. When the adhesive is exposed to an energy "trigger", the dual stage PSA transforms into the second



state where the chemistries react, altering the chemical and physical characteristics of the adhesive to meet a specified performance characteristic, such as chemical resistance, clean conversion or barrier properties.

Because dual-stage PSAs can be triggered with energy forms other than heat, they can be used in place of heat curable thermosetting adhesives and with heat sensitive substrates, such as polypropylene, HDPE, and PET.

Uses of Dual-Stage Technology

There are many potential functions or applications of dual-stage PSA technology that can benefit from the convenience of a PSA product with on-demand triggers. AR is focusing on three primary functions of the technology:

- Forming stronger bonds or seals that are resistant to chemical exposure
- Enabling deactivatable bonds for separating rigid-to-rigid surfaces
- Improving processability, such as cleaner cuts during die-cutting

One specific application area of interest is for the encapsulation/packaging of delicate electronics such as liquid crystal displays (LCDs) and organic light emitting displays (OLEDs). The dual-stage PSA is used to form a rapid but temporary seal for the active electronics that is subsequently triggered and converted to a permanent bond to protect against oxygen, moisture, and mechanical damage. This environmental seal plays a crucial role in providing an acceptable lifetime to these devices.

Dual-stage technology can also be used in device assembly where a rapid fixturing of parts with strong resistance to chemical environments is required. This technology also lends itself to clean die cuttability, a highly desired feature for uninterrupted running of the manufacturing equipment.



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