Tech Tip 27

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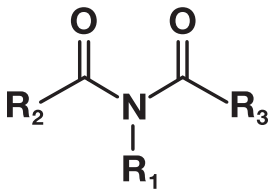
Polyimides

What >
Understanding Polyimides

Why > Polyimides are high temperature materials with excellent chemical and solvent resistance



Imide Group

Definition

Polyimides are synthetic polymers containing two acyl groups (C=O) bonded to nitrogen (N); known as imides. They are supplied as a one component system and typically contain solvents. Polyimides are known for their flexural strength, flame resistance and chemical resistance, as well as high temperature performance in the 400-500°C range.

Why are Polyimides Important?

Polyimides are commonly used as a coating due to their solvent containing formulations. This translates to a material that is better suited for large surface areas, instead of adhesive glue joints. As a coating, polyimides have enough adhesion to the primary surface, where performance is quantified using a scratch or abrasion test. As an adhesive, we find them less effective in structural bonding applications, versus epoxy-based chemistry. Users of polyimides should expect at least ⅓ to ½ of ultimate strength, compared to a similar epoxy glue joint.

Often times, a polyimide is chosen due to its inherent ability of being flame resistant. This is an environmental advantage because trade restricted flame retardants, such as antimony compounds and red phosphorous structures, are not needed.

Types of Polyimides

Polyimides exist in two formats: thermosetting and thermoplastic. Thermosetting polyimides have a glass transition temperature (Tg) and a non-reversible polymerization process; where the starting materials cannot be reclaimed. By contrast, thermoplastic polyimides have a melt temperature (Tm) and will revert back to their original format (i.e. liquid or paste) once this temperature is reached.

Applications of Polyimides

- Jacketing or jacket coatings, insulation layers and composite impregnation on electronic and coaxial cables
- Insulation and a protective layer for magnetic wires
- Composite plastics, where polyimide impregnates woven or non-woven carbon and glass fiber cloth, resulting in a PCB substrate, such as Kapton®, and molded plastic parts such as Vespel®
- Medical grade molded plastic parts and tubing
- Semiconductor wafer passivation layer
- Coating optical fibers

EPOXY TECHNOLOGY

Processing of Polyimides

Since most polyimides are supplied in a solvent containing format, special attention is needed when handling and curing. For handling, it is important to be mindful of the dry time. The dry time, similar to working time, is the time you have to work with the material when it is out of the original jar. This may yield only minutes or hours on a screen printer or dip coater, due to evaporation rates. In terms of curing, a solvent-borne product will typically require a multi-step curing procedure in order to avoid trapped pin holes, or bubbles, in the coating or adhesive layer. As with all solvent-borne materials, proper ventilation of the laboratory and curing ovens is important. It is also important to note that the shelf life cannot be extend by adding additional solvent to the material.

EPO-TEK® Polyimide Product Line From Epoxy Technology

Product	Application/Comments
	Thermoplastic
OE132-43	Slow drying, optically transparent, high temperature coating for fiber optics, medical catheters and industrial flow meters (REACH compliant).
	Thermoset
P1011	Low stress, long dry time, silver-filled for chip bonding in microelectronics and optoelectronic applications. Designed for screen printing and dispensing.
P1011S	Low stress, long dry time, silver-filled for semiconductor die attach and hybrid microelectronic packaging. Lower viscosity version of P1011. Designed for die-stamping and pin transfer.
TV1002	Black-colored, high Tg, low outgassing, slow drying with high strength for wafer passivation and performance up to 450°C. Designed for ultra-fine screen print definition.
TV1003	White-colored, high viscosity, high Tg, low outgassing, slow drying with very high dielectric strength for wafer passivation and alpha particle protection. More electrically insulating version of TV1002. Designed for ultra-fine screen print definition with performance up to 450°C.

Conclusions

Polyimides are high temperature, flame retardant materials that exist in thermoplastic and themosetting versions. They are commonly used as a coating or jacketing material on electronic and optical cables, as well as a wafer passivation dielectric.

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