Phase-Change Thermal Management Materials Go Printer-Friendly

by Jason Brandi, Henkel Corporation

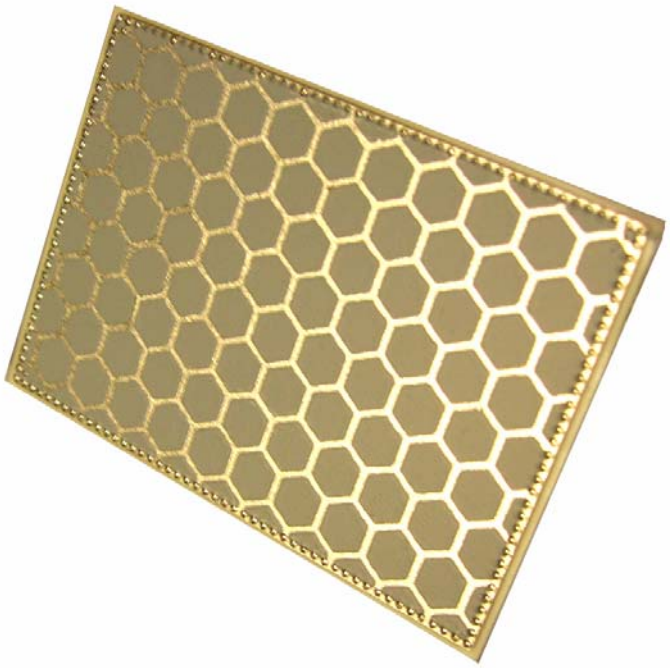
As the industry has driven toward smaller and smaller devices, thermal management has become an even more challenging proposition. These miniaturized packages, of course, aren't just smaller form factor, but are also highly functioning, which generates more heat. And, while old standbys like thermal greases and phase-change materials in pad formats are adequate from a thermal management perspective, they aren't necessarily the most user- or process-friendly solutions for today's high-throughput requirements.

Thermal greases are arguably the most well-known of the various thermal management materials on the market. Applied in liquid form, the grease stays in a liquid state for the life of the product. The wetting of greases is very good, which is why some manufacturers prefer this material. However, this wetting advantage also has tradeoffs. Because greases are always in a liquid state, they can be extremely messy in a production environment and, generally speaking, there is a fair amount of material waste (read: more cost). Secondly, and perhaps the most important consideration, is that greases can lose their effectiveness over time. Continual thermal cycling of greases can lead to liquid migration, leaving only the filler in place, which eliminates surface wetting and leads to possible field failures. The differing expansion rates of the materials on either side of the interface can create a "pumping" effect, which results in increased thermal impedance and inadequate thermal transfer.

To address the issues associated with thermal greases, phase-change thermal interface materials (TIMs) were developed and introduced to the market over 20 years ago and have since gained widespread acceptance for their ease of use and exceptional performance. Traditionally supplied in pad format, phase-change TIMs are solid at room temperature and become liquid only when heat from the device pushes the material past its melt point (45°C). Unlike thermal greases, phase change materials will not migrate or "pump out" over time. Because they are applied as pads, phase-change materials do have some limitations. Pad thicknesses and sizes are pre-determined, so manufacturers are restricted in terms of application thickness and/or pattern preference. In addition, applying pads is most often achieved manually. While there are automated tape and reel options, the majority of manufacturers prefer to adhere the phase-change pads by hand, which adds operator intervention and production time.

Recently, Henkel has formulated a new class of phase-change thermal interface materials that solves many of the process limitations of greases and pads. Under the well-known Loctite® PowerstrateXtreme™ (PSX) product line, Henkel has launched three new printable phase-change formulations. These new materials, called Loctite PowerstrateXtreme Dispensable (PSX-D) and Loctite PowerstrateXtreme Printable (PSX-P), are phase-change materials in liquid form that offer many of the usability and throughput advantages of thermal greases without any of the drawbacks. Loctite PSX-D is a fast-drying paste that can either be needle dispensed or manually screen printed.

For manufacturers that prefer more print flexibility for automated screen printing systems, Loctite PSX-P is offered in both medium dry and extended dry versions. With the extended dry formulation, abandon time is 2 hours minimum. Both Loctite PSX-D and Loctite PSX-P products are pastes that are liquid when applied and, once dry, yield a phase-change pad. The reliability and performance of the materials are consistent with that of Loctite's PowerstrateXtreme phase-change film-based materials but, because they are liquids, thicknesses can be adjusted as required. While films do come in a variety of thicknesses, thinner films are difficult to manufacture and often are even more difficult to handle, often resulting in incomplete release from the liner. Loctite PSX-D and Loctite PSX-P solve this problem by offering a material that allows for complete control of application thickness and pattern. In addition to these production advantages, Loctite PSX-D and Loctite PSX-P can be fully automated, thus improving throughput. Plus, the materials are adaptable to current equipment systems, so no new capital expenditure is normally required. Other advantages include the materials' adaptability to deviations in surface flatness with the ability to fill any voids with varying thicknesses, simplified handling due to its room temperature dry state and, of course, improved long-term reliability because of the elimination of "pump-out".



Henkel's new Loctite PSX-D and Loctite PSX-P materials extend the PowerstrateXtreme brand even further, offer exceptional, proven performance with the added benefits of improved throughput, lower overall manufacturing costs and process versatility. No longer does the miniaturization model have to mean more complicated processes – at least not for thermal management and Loctite PowerstrateXtreme.

For more information on Loctite PSX-D and Loctite PSX-P or any of Henkel's advanced thermal management products, call the company's headquarters at 949-789-2500.