Surface Mount Technology Online Article

Hot Topics: Solving an Industry Dilemma with Emerging Technologies

Dealing with the Lead-free Challenge

By Joe Fjelstad, Verdant Electronics

The impact of banning lead has long been decried by leading electronics technologists as risky, and anecdotal evidence is building that they were right. Further detriments include cost and thermal issues. The answer is avoiding solder when possible.

In spite of scientific evidence that lead-free solder is more damaging to the environment than traditional solders, and that the risk of harm from the 0.5% of metallic lead used in electronic assemblies never has been substantiated, the EU's RoHS restrictions are now in place and other countries around the globe are following suit with copycat legislation. Solder assembly has never been a perfect technology, but the unsung heroes in the trenches of the EMS industry have made steady improvements in process yield. Still, there are practical limits — pitches continue to shrink and soldering temperatures continue to rise. Some promise rests with future nanotechnology solders to ameliorate thermal problems, though it is unlikely that they will cost-compare to current solutions.

Given the ongoing challenge, one might ask: Is there another way? And there is. The answer is the avoidance of solder when the design will allow. A solderless assembly concept presently is being investigated by companies in many parts of the world as a means of getting out from under the heavy burden of lead-free solder. Interest has come from those charged with manufacturing high-reliability military hardware. While such suppliers are exempt from the lead-free mandate, they are increasingly unable to procure parts with traditional tin/lead solder finishes. It places them in an unanticipated bind following their earlier efforts to meet customer cost targets by converting to COTS hardware. Others are producing portable electronics. In 2006, a large batch of Swatch watches were recalled — tin whiskers were blamed.

There are other significant advantages to going solderless. Examples include design security because components are encapsulated, eliminated lead screenings, intrinsically RoHS-compliant product, lower energy use in manufacture, no MSL/popcorning concerns, etc. While it is likely that solder will remain in use for many years to come, solderless assembly of electronic appears to be well suited to addressing some of big challenges facing the electronics industry. The ultimate answer to the many problems of lead-free solder may well in found in its avoidance.

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Keeping Pace with Miniaturization
By Arthur L. Chait, CEO, EoPlex Technologies Inc.

Today's devices demand increasingly complex components in smaller sizes. The champion example is the semiconductor industry, where 200 million transistors can fit within the area of a pinhead. But, outside the world of semiconductors, it is still a struggle to design and manufacture these devices, especially where the device contains different materials, such as conductors and dielectrics. Some remain either impossible to mass produce, cost prohibitive, or both. It is often the role of a start-up to provide innovation that solves this issue.

Up to this point, the tools generally used to make parts such as these run from basic assembly to various micro-techniques to MEMs and even nano methods. Assembly is useful for some miniature parts, but requires automation and low cost labor and many parts still cannot be made cost effectively. MEMS and related technologies work well with one or two materials, like silicon.

However, very few technologies can handle several different materials simultaneously, with complex geometries, in small parts. Devices that often require the true innovation to meet this challenge include miniature fuel cell reformers, energy harvesters, antennae, and others.

Building miniature parts with multiple materials requires engineered inks that build multi-material complex shapes in layers. Metals, ceramics, polymers, and void spaces are built into thousands of parts per production batch. The manufacturing process relies on these inks to decompose when heated, leaving behind compatible dielectrics, conductors, and open spaces. Parts can contain hundreds of layers with thicknesses that range from microns to millimeters. Some parts may require hundreds of layers to achieve the proper resolution, while simpler parts only require about 30 layers.

Cell phone ancillary antennae are used for Bluetooth, GPS, WIFI and other applications. A modern phone may contain five or more antennae and — to conserve space and preserve feature richness — these must be very small. To achieve high performance in a small, low-cost package, the industry has turned increasingly to dielectric ceramic antennae as the preferred solution. However, dielectric antennae require integration of complex ceramic and metal patterns, with open spaces, and in small dimensions. The production process must be scalable to high volumes, since cell phone production has already passed one billion units per year. This calls for an authentic leap of innovation.

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