Application of package-level high-performance EMI shield material with a novel nozzleless spray coating technology

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Abstract – The need for EMI (electromagnetic interference) shielding at the package-level is increasing as highly sensitive circuit assembly components become more tightly packed in items like smart phones and Internet of Things (IoT) devices. Traditionally, EMI shield coatings have been applied to individual components by sputtering or plating. The ideal properties for this EMI shield is a thin metallic layer less than 10 µm in thickness that provides the required shield effectiveness, adheres to the component surface, and ensures that the laser markings on the component surface are visible. New, high-performance EMI shield coatings have been developed that meet these requirements and can be applied using a direct spray process.

These new sprayable coatings will provide highly effective EMI shield performance if they are applied uniformly and conformally to the package surfaces at the required thickness of generally less than 10 µm. A novel spray application method, T-CAT (ultra-Thin Coating Application Technology), can be used to apply a uniform, ultra-thin layer, while reducing the process cost by up to 60%.[1] This new spray technology consists of a novel nozzle-less ultrasonic spray head coupled with a precision motion and positioning platform, precision liquid delivery system, and substrate transport system.

A new high-performance EMI shield coating has been developed specifically for application by the spray coating process. This new material consists of a combination of silver nano particles and silver coated copper micron-size particles suspended in an epoxy resin binder. The epoxy resin binder has excellent adhesion to the surface of the individual components without the need for special surface treatment. The material is also capable of providing the same EMI shield effectiveness as a coating layer applied by sputtering as long as the coating is applied in a uniform and conformal layer to the top and side surfaces of the components.

There are significant challenges connected with the application of EMI shield coatings to individual components in a production process. The coating application system must be able to keep the coating material properly mixed as well as apply it at the required thickness uniformly and repeatably over time.

This paper demonstrates the viability of T-CAT in conjunction with a unique metal and resin formulation technology to enable a thin EMI shield layer with superior performance compared with existing sputtering and plating methods. Performance characteristics of the coating material and the coating application process will be examined.

Key words: nozzle-less spray; ultrasonic spray coating, EMI shield, EMI shield materials, component levelshielding, advanced packaging

T-CAT ULTRATHIN COATING APPLICATION TECHNOLOGY

As highly-sensitive components become more closely packed in circuit assemblies, the need for EMI shielding is increasingly required. This trend toward miniaturization while minimizing weight and thickness necessitates that each individual package have EMI shielding.[2] The most commonly used methods to apply component-level EMI shielding layer between 3 and 10 µm thick have been sputtering and plating. However, these traditional methods require substantial capital investment and complex process flow while providing limited to moderate throughput.

In the past few years, new EMI shield coating materials have been developed that can be applied with a simpler direct-spray coating process. These materials are high-density slurries with proprietary formulations that produce a continuous conductive layer on the substrate after coating and curing. When applied in a uniform and conformal layer, these new materials provide excellent EMI package-level shielding characteristics. A direct-spray application process, such as T-CAT, enables manufacturers to have a straightforward path to increased design flexibility, higher packaging densities for smaller, lighter device designs, and less complex bill of materials.

Ultra-Thin Coating Application Technology (T-CAT) is a direct-spray method used for applying thin and uniform coating layers to a variety of substrates across several markets including alternative energy, semiconductor and medical. It is capable of spraying a wide variety of materials including pure solutions, suspensions, and slurries while producing a uniform coating layer on the substrate.[3] T-CAT is also used to apply "conformal" layers of coatings to surfaces with 3D microstructures.[4]

In the case of package-level EMI shielding, T-CAT is used to apply a uniform and conformal layer on the top and side surfaces of individual components at the specified thickness. T-CAT incorporates a proprietary "nozzle-less" ultrasonic spray technology as the method to spray the high-density EMI coating slurries. The automated coating system platform includes the nozzle-less ultrasonic spray head assembly, a precision metering and mixing liquid delivery