Advanced Packaging for Wearables

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Abstract

The human body is very complex in nature that varies in shape and size. Our bodies expand, contract, flex and can get dirty, wet, and bumped. Conventional IC packages and boards are rectangular and are assembled using classic equipment and processes that move along Cartesian axes; side to side and up and down. There is a gap, which our industry can address. Packaging plays an important role in solving these challenges. Flexible, ergonomic and robust solutions are required to successfully implement these types of sensors and generate the accurate data that is required to maintain human health. This presentation will focus on the packaging of different sensors and signal chains onto flexible substrates and the integration of those assemblies into enclosures that will enable vital signs monitoring around the body.

These signal chains may include sensors, amplifiers, data converters, processors, RF and power management. The power management includes batteries; either disposable or rechargeable. Substrates that are flexible and comfortable, yet have the interconnect density required to bond and route among the various die and passive components, are required to enable these full signal chains. Two commonly available flex technologies are converging in this space; pattern plated and printed. Plated has the capability for fine pitch interconnect, while printed can support the cost and size requirements of, for instance, crossing our chest between ECG sensing nodes. Printed flex line & space and via technologies today don't allow the same levels of integration. There is a real opportunity for our industry here. Once a flexible substrate like this is assembled, it needs to be enclosed in materials (often textiles) that can be comfortably adhered to the skin or integrated into clothing. These materials need to maintain the ergonomic feel, while protecting the electronics from moisture and mechanical damage.

This level of integration requires advances in design and simulation tools and capabilities, new at least to IC package engineers. The complexity of packaging, variations in interconnects and often increased number of interfaces and bond layers raise reliability and FA challenges that we have not faced in conventional IC packaging. Much progress has been made, but there remains a long road ahead for our industry to enable the pervasive use of these remote vital signs monitoring sensor nodes.