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Development of In-House ACA Hybridization Technologies for Next-Generation Hybrid Pixel Detectors

A reliable and cost-effective interconnect technology is required for the development of hybrid pixel detectors. The interconnect technology needs to be adapted for the pitch and die sizes of the respective applications. This contribution presents recent results of a newly developed in-house single-die interconnection process based on Anisotropic Conductive Adhesives (ACA). The ACA interconnect technology replaces solder bumps with conductive micro-particles embedded in an epoxy layer applied as either film or paste. The electro-mechanical connection between the sensor and ASIC is achieved via thermo-compression of the ACA using a flip-chip device bonder. The ACA technology can also be used for ASIC-PCB/FPC integration, replacing wire bonding or large-pitch solder bumping techniques. A specific pixel-pad topology is required to enable the connection via micro-particles and create cavities into which excess epoxy can flow. This pixel-pad topology is achieved with an in-house Electroless Nickel Immersion Gold (ENIG) process. The ENIG and ACA processes are qualified with a variety of different ASICs, sensors, and dedicated interconnect test structures, with pad diameters ranging from 12 µm to 140 µm and pitches between 20 µm and 1.3 mm. The produced assemblies are characterized electrically, with radioactive-source exposures, and in tests with high-momentum particle beams. This contribution introduces the developed interconnect and plating processes and showcases different hybrid assemblies produced and tested with the above-mentioned methods. A focus is placed on recent optimization of the plating and interconnect processes and new results obtained with an expanded set of test structures and device types to improve statistical significance.

Title

Development of In-House ACA Hybridization Technologies for Next-Generation Hybrid Pixel Detectors

Topic

Solid state sensors

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