Contribution ID: **10** Type: **WG7 - Interconnect**

Interconnections and multi-chip flex developments

Wednesday, June 19, 2024 1:30 PM (15 minutes)

A significant effort is underway to develop large area and lightweight modules using monolithic sensor demonstrators. These studies are performed within CERN's R&D programme on technologies for future experiments (EP R&D). A novel flex PCB has been designed to reduce the material budget as much as possible while ensuring dense packaging maximising the active area in the detector. Scalable interconnection technologies enable production targeting large detector surfaces. These technologies include ACF/ACP (Anisotropic Conductive Film/Anisotropic Conductive Paste), epoxy-supported gold studs, and nano-structured pads (nanowires). Nano-wires have been deposited with a diameter of 0.4 - 0.6 µm and a length of 3-5 µm onto sensor pads of a monolithic sensor chip (MALTA2). The optimized process has demonstrated a near 100% pad yield, enabling usage on large chip quantities at wafer level. It further allows for the reliable bonding of sensors housing a large number of bond pads. We show how nano-wires can be used in different bonding methods such as cold welding, copper sintering, and glue-assisted bonding enabling the bonding of a wide variety of pad geometries. The current smallest inter-pad distances on MALTA2 are 32 µm while the process has the potential to interconnect pitches down to 8 µm. The presented interconnection technologies are essential to overcome the minimal distance requirements of the wire bonding process while reducing parasitics, and enabling denser packaging over a wide signal frequency range. To demonstrate the capabilities of the flip-chip bonding technology for minimal material module integration, a flexible PCB with a thickness of ˜30 µm and track widths down to 17 µm has been produced. This allows for design flexibility in the support structure, including features such as flaps providing backside biasing onto the rear of the chips it houses. This structure can provide a homogeneous electrical field in the sensor which contributes significantly to its stable performance. Besides the sensor integration on the flex using multiple technologies, the reliable integration of passive components as well as a 140-pin connector on a 5 µm copper layer via reflow solder is shown. This talk will summarize the test results of demonstrator modules as well as of the interconnection studies. An outlook for a compact silicon pixel module concept as well as the necessary interconnection technologies for future experiments, with a high active area, minimal material, and potential for scalability will be presented.

Type of presentation (in-person/online)

in-person presentation

Type of presentation (scientific results or project proposal)

Presentation on scientific results

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Session Classification: WG7/WP4 - Interconnect technologies