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Development of Silicon Interposers with Embedded Microchannels and Metal Re-distribution Layer for the Integration of Hybrid Detector Systems

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One of the important challenges in the current radiation detector applications, as we advance in the further integration of the systems, is the cooling of the detectors. The larger heat densities, combined with the complexity of hybrid detector assemblies, complicate the full integration of the sensors, electronics, and services in the whole system. In order to overcome these difficulties micro-channel cooling has been proposed to increase the cooling efficiency, reducing the heat transfer path to the detector volume and therefore increasing the heat removal performance, while improving the integration of the cooling with the detector and front-end electronics hybrid system.

In this work, we present the development and fabrication of silicon interposers with buried micro-channels, which also incorporate a metal re-distribution layer (RDL) to contribute further in the integration of the system. These interposers are proposed for their application both in future high energy physics experiments and for advanced systems in photon science where the thermal, material, and integration requirements are very demanding, therefore they can benefit from these developments.

The microchannels and the metal tracks are created in several fabrication steps which will be described. Two methods have been followed to produce these interposers, called "pre-processing" and "post-processing", depending on whether the micro-channels are created before or after the metal lines. The advantages and disadvantages of the two approaches will be presented based on the multiple analysis techniques used to evaluate the different fabrication methods and to assess the final quality of the interposers. Additional considerations will be made on the potential of alternative technologies available to create interposers for further applications. With the advent of the Through Silicon Vias (TSV) technology, the proposed solution would provide further alternatives for the electrical interconnection of the detector/electronics hybrid with the external world, facilitating the signal and power input/output.

Submission declaration

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