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Microchannel Cooling Developments at IMB-CNM

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The progressive shrinking of dimensions and system integration in radiation detector systems for experimental physics introduce important challenges for the cooling of sensors and electronics. The increased heat densities, combined with the complexity of detector assemblies, make the full integration of the sensors, electronics, and services more and more complex. In order to overcome these difficulties microchannel 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 sensor and front-end electronics hybrid system. We will present the technological developments carried out at CNM in the field of microchannel cooling.
In the past we already developed a technology of embedded microchannels on silicon substrates by the use of Deep Reactive Ion Etching (DRIE) and wafer bonding techniques and demonstrated the successful liquid flow and cooling performance. Now we work on adding interconnection functionality to cooling interposers with embedded microchannels. The developed interposers provide mechanical support and high-efficient cooling. We will present the extension of the microchannel technology to incorporate a metal redistribution layer (RDL) in order to facilitate the interconnection of the signal and power with the backend electronics. Additionally, we work on the full integration of the microchannels with the sensors itself. Several techniques can be applied for this purpose, and they present different advantages and challenges. We will select the optimal technology to achieve the full integration.

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