



Contribution ID: 14

Type: poster

3D Integration Technology using Through Silicon Vias for Hybrid Pixel Detector Modules

Hybrid pixel detector modules are the main building blocks of silicon particle tracking detectors in high energy physics experiments as well as in x-ray cameras for research and development using synchrotron radiation. Wire bonding is used so far to connect the readout ICs to the detector services. The 3D integration technology with through-silicon-vias (TSVs) offers several advantages in terms of reduction of peripheral area of hybrid modules as well as reduction of signal path length for fast signal readout. A via last approach for electronic readout ICs using copper-filled through-silicon-vias will be described in this presentation. Starting with the description of the individual process steps for TSV formation the specific details of the technology for different types of readout ASICs will be described. Due to the fact that the TSV connects the inner layers of the IC with the IO-redistribution layer of the chip backside the details of chip design has to be involved in the process development already at an early state. The application of TSV process will be shown on several types of electronic readout ASICs, i.e. ATLAS FE-I4B and MEDIPIX3. Depending on the status of process development at the time of presentation the talk will give the current state of test results of 3D integrated pixel detector modules.

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