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Characterization of Indium Phosphide sensors for future large-scale thin film detectors

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Charged particle tracking detectors with very precise spatial and temporal resolution are a vital component of future high-energy and nuclear physics experiments. Thin film technology, as used e.g. in LCD displays and photovoltaics, could enable the fabrication of large-area, low-mass detectors in a straightforward and cost-effective way. In addition, physical and chemical vapor deposition methods could be used to fabricate tracking devices made from many other semiconductors besides Silicon. Potential new material candidates for charged particle tracking and photon detection are identified by properties such as band gap, resistivity, charge carrier mobility and charge collection efficiency.

This presentation focuses on Indium Phosphide (InP), which stands out as having a significantly higher electron mobility (>4500 cm^2/Vs) than Si and has found use in optoelectronics and high-frequency electronics. Single-pad sensors and 5x5 pad arrays were fabricated at Argonne National Laboratory on commercially available 350-μm thick InP:Fe wafers. The devices were characterized with CV-IV measurements, as well as with red laser TCT and beta particles from a Sr-90 source. It is shown that these comparatively thick sensors, with no particular design optimization nor gain implant, can reach a timing resolution of ca. 35 ps on a fast 1-ch UCSC readout board. Spatial scans with the red laser on 5x5 arrays and pronounced opposite-polarity cross-talk between pads are demonstrated. Preliminary results from focused X-ray test beams will also be discussed.

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