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Advances in Large Area MCP-PMTs

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Large Area Picosecond Photo-Detectors (LAPPDs) produced by Incom Inc. are the world's largest commercially-available planar-geometry photodetectors based on microchannel plates (ALD-GCA-MCPs). It features a chevron pair of "next generation"large area MCPs produced by applying resistive and emissive Atomic Layer Deposition (ALD) coatings to borosilicate glass capillary array (GCA) substrates encapsulated in a borosilicate glass or a ceramic hermetic package. These are available with 10 or 20 μm pore diameters.

A VUV-grade fused silica entry window of the detector is coated with a high sensitivity semitransparent bi-alkali photocathode with roughly 20 cm X 20 cm detection area.

Signals are read out via a capacitively coupled resistive anode. The "baseline"devices have demonstrated electron gains of 1E7, low dark noise rates (<1000 Hz/cm2), single photoelectron (PE) timing resolution less than 50 picoseconds RMS (electronics-limited), and single photoelectron spatial resolution under 1mm RMS (also electronics-limited), high (25% - 30%) QE uniform bi-alkali photocathodes.

Incom Inc. has recently started manufacturing a smaller format, 10 cm X 10 cm High Rate Picosecond Photo-Detector (HRPPD). In addition to all of the LAPPD attractive features, HRPPD has a fully active area with no window support spacers (structural supports). It is equipped with new 10 μm pore MCPs and a highly pixelated anode with either capacitively of directly coupled readout to provide sub-mm spatial resolution. In comparison with LAPPDs, HRPPD prototypes demonstrated similar gain and dark rates but higher spatial resolution.

Measurements with LAPPDs and now HRPPDs operating in strong magnetic fields have been performed. Stable high gain LAPPD and HRPPD operation was demonstrated at magnetic field strength of up to 2 T.

LAPPDs and HRPPDs are good candidates for neutrino experiments, HEP experiments, neutrinoless double-beta decay experiments, medical and nuclear non-proliferation applications. Currently, customized HRPPDs with a pixelated direct readout are being developed to be employed in pf-RICH modules of ePIC detector in EIC.

We report on the recent progress in the production and development of the LAPPDs and HRPPDs. Ongoing efforts on development of wide temperature range MCPs and red-enhanced photocathodes, extending sensor lifetime and enlarging sensor active area will also be discussed.

Early Career

Yes

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