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Extended lifetime MCP-PMTs: Characterisation and Lifetime measurements of ALD coated Microchannel Plates, in a sealed photomultiplier tube

Atomic Layer Deposition (ALD) coating of Microchannel Plates (MCP) has been shown to offer significant performance advantages MCP-PMTs. ALD is a chemical process used to deposit atomic mono-layers on a substrate. A process has been developed to deposit a surface with improved secondary emission yield on to a MCP substrate. The principal advantage of a higher SEY is the ability to achieve significantly higher gain at the same operating voltage across a single MCP. Further to this, it is suspected the atomic mono-layers deposited by ALD coating prevents desorption of gaseous contaminants in the MCP glass. The ions produced during desorption are widely believed to be a direct cause of photocathode aging in MCP-PMTs, leading to the hope that ALD coating can improve MCP-PMT lifetime.

To fully characterise the performance of ALD coated MCPs two MCP-PMTs were manufactured, one ALD coated and the other used as a control. Each detector's gain, DQE, pulse shape and timing jitter were measured followed by a life test of the tubes. The ALD coated tube was found to have a higher gain at the same operating voltage, whilst being equivalent to a standard MCP in other performance characteristics. ALD coating gave a dramatically improved life time, after 5.16 C/cm² total charge extracted, there was no measurable effect on photocathode QE, although MCP gain dropped by approximately 35%.

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MCP detector development

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