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Atomic layer deposition of nano-composite films to produce large area microchannel plates for electron amplification

Microchannel plates (MCPs) are excellent electron amplifiers and when incorporated into photodetectors they provide a combination of unique properties such as high gain, high spatial resolution, high temporal resolution and low dark current. MCPs can be used in wide variety of applications such as imaging spectroscopy, photodetectors for high energy physics and astronomy, time-of-flight mass spectrometry, molecular and atomic collision studies, and cluster physics. The same MCP-based technology is used to make visible light image intensifiers for night vision devices. Through the Large Area Picosecond PhotoDetector (LAPPD) program based at Argonne, we developed a cost-effective and robust Atomic Layer Deposition (ALD) nano-composite thin film technology to fabricate large-area (8"x8") microchannel plates. Here we have tailored the electrical resistance and secondary electron emission (SEE) properties of large area, low cost, borosilicate glass microcapillary arrays to produce MCPs with high gain, low noise and long life. We have developed several robust and reliable ALD processes for the resistive coatings and SEE layers to give us precise control over the resistance in the target range for MCPs (10e6-10e9Ω) and SEE coefficient (up to 8). These MCPs were found to provide high gains of up to 10e7 (chevron pair). Here, the latest developments in the ALD nano-composite materials will be presented.

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