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Composition and thickness dependence of electron-induced secondary electron yield for MgO and Al₂O₃ from atomic layer deposition

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This work is a part of the Large-Area Picosecond Photo-Detector collaboration (LAPPD, <http://psec.uchicago.edu/>), which is focused on the development of the next generation photon-to-electron converters using novel materials synthesis approaches to obtaining desired functionality. Large-area micro-channel plates are being developed for this effort using more affordable micro-porous glass, as opposed to the original lead-glass. Using atomic layer deposition (ALD), these plates are functionalized with the conformal coatings of materials with enhanced secondary electron yield (SEY). The characterization of two candidate electron amplifying materials, MgO and Al₂O₃, has been performed, aimed at determining how surface chemical composition, electronic structure, and film thickness affect the SEY. The extensive data found in literature on a given material from different experiments show significant variation that is most likely influenced by the experimental apparatus, as well as by sample preparation and handling. In an attempt to shed more light on this subject, we have assembled an ultra-high vacuum system containing X-ray and ultraviolet photoelectron spectrometers (XPS and UPS, respectively), and a low energy electron diffraction (LEED) module for SEY measurements. The LEED module, which combines electron source and collector, can be used for characterization of samples crystallography, and elemental composition by Auger electron spectroscopy (AES) in smaller areas than XPS.

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