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Modeling optical interference effects for optimization of electron emission properties from thin film semiconductor photocathodes

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High-quality electron beams are critical for generation of intense X-ray pulses from free electron lasers. It was proposed that complex thin films and heterostructures with semiconductor photoemissive layers may be used in photocathodes to produce electron beams with better quality. New developments in material science allow designing alkali-antimonide photocathodes with specific coatings that could significantly increase their lifetime while not markedly degrading their quantum efficiency (QE). Moreover, results from recent experiments demonstrated that QE can be increased by optical interference absorption effects in layered materials. Modeling of these complex photocathode material designs is needed to predict and optimize their electron emission properties. We apply recently developed extended moments and thin film models to evaluate quantum efficiency and intrinsic emittance from thin film cesium-telluride and alkali-antimonide semiconductor photocathodes grown on different substrates. We will discuss simulation results and suggest possible ways to optimize electron emission properties from these thin films photocathodes.

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