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Pulsed laser deposition assisted epitaxial growth of cesium telluride photocathode for high brightness electron source

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Photocathodes play an integral role in the development of electron accelerators and photon detectors. In spite of having an ultrasmooth photocathode developed by a co-deposition process [Gaowei et al (2019)], there are still limitations on emitted beam brightness by the surface and bulk disorder of the polycrystalline photocathode material. Epitaxial growth of photocathodes has the potential to overcome this problem and achieve high-brightness electron beams [Parzyck et al (2022)]. This work demonstrates the epitaxial growth of Cs2Te photocathodes on a variety of single-crystal substrates. In our study, the growth of an epitaxial layer with a flat surface and high crystallinity is confirmed by reflection high energy electron diffraction (RHEED) for the Cs2Te thin film. In situ x-ray characterization is used to confirm the film stoichiometry, surface roughness, and crystallinity. Spectral responses are observed, where Cs2Te thin film photocathodes with a Quantum Efficiency (QE) of about 17 % of peak value at 270 nm are obtained from epitaxially grown Cs2Te with a film thickness ~ 20 nm and with a surface roughness of less than 1 nm.

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