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CsK2Sb-photocathodes for application in an industrial accelerator

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The LightHouse project is a novel industrial application of an electron accelerator for the production of medical isotopes (99Mo) as an alternative to nuclear reactors.
In the framework of the SMART project of the company Institut National des Radioéléments (IRE), RI is responsible for the superconducting electron accelerator which includes the DC photoinjector, the SRF modules and the entire beamline for a 75Mev, 40mA, 3 MW cw beam to the target.

One subproject is the production and supply of the photocathodes for the photoinjector. Therefore, RI built up a beam test facility which includes the injector, a deposition chamber, and an automated transfer line to bring the photocathodes from the deposition chamber to the gun keeping the cathodes in a common ultra-high vacuum system.
The photocathodes are based on typical sequential deposition recipes of CsK2Sb-cathodes [1-3] on Mo and SS substrate. An advantage of the deposition chamber is the use of thermal effusion cells which can be filled with a few grams of alkali metals. The alkali metals are alloyed into indium in order to increase the evaporation temperature. This allows the production of more than 20 photocathodes without the need to refill the evaporators.
First results show that photocathodes with a QE> 4% can be produced reliably and can be transported from the deposition chamber into the gun without a measurable degradation.

[1] Schmeißer, M. "Photocathodes for high brightness, high average current photoelectron injectors."Dissertation Humboldt-Universität zu Berlin (2019)
[2] Wang, E., et al. "Long lifetime of bialkali photocathodes operating in high gradient superconducting radio frequency gun." Scientific Reports 11.1 (2021): 1-9.
[3] Bazarov, I., et al. "Chapter 7: "Semiconductor photocathodes for unpolarized electron beams."An Engineering Guide to Photoinjectors, T. Rao and D. H. Dowell, Eds. (2013): 184-217

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