A Colored Cesium Iodide Photocathode Excited by 405 nm Irradiation

Yao-Te Cheng, Juan R. Maldonado, Piero Pianetta, R. Fabian Pease, and Lambertus Hesselink
Department of Electrical Engineering, Stanford University, Stanford, CA 94305
ytcheng@stanford.edu

For the development of a new X-ray imaging system we have been seeking a compact, rugged photoelectron source with a current density at least 10 A/cm^2. In prior work[1], we described a photocathode comprising a film of CsBr on metal film on a sapphire substrate excited with 405nm radiation; a novel feature of that cathode was the use of prior activation by 0.5-2 keV electron bombardment presumably to generate color centers which allowed the use of much more compact 405 nm lasers (than the 257 nm lasers used previously[2]). Here, we describe the use of a similar approach but replacing CsBr with the more rugged CsI. Preliminary results at 405 nm have been encouraging. After 1 keV electron beam bombardment of a 15 nm thick CsI film, the photoelectron yield was increased by more than 3000X compared to the same CsI photocathode before the e-beam treatment (figure 1). Photoelectron yields exceeding 200 nA/mW have also been demonstrated. This is similar to the earlier results achieved with CsBr but is surprising in view of the earlier work of [ref. 3] who reported that electron bombardment did not generate color centers in CsI. Experiments are continuing to characterize the photoelectron yield as a function of time, ambient vacuum and prior electron bombardment.

[1] J. R. Maldonado, Y. Cheng, P. Pianetta, F. W. Pease, and L. Hesselink, Appl. Phys. Lett., 105, pp. 021108 (2014).
[2] J. R. Maldonado, S. T. Coyle, B. Shamoun, M. Yu, M. Gesley, and P. Pianetta, J. Vac. Sci. Technol. B 22(6), pp. 3025-3031 (2004).
[3] P. Avakiant and A. Smakula, Phys. Rev. 120(6), pp. 2007-2014 (1960).

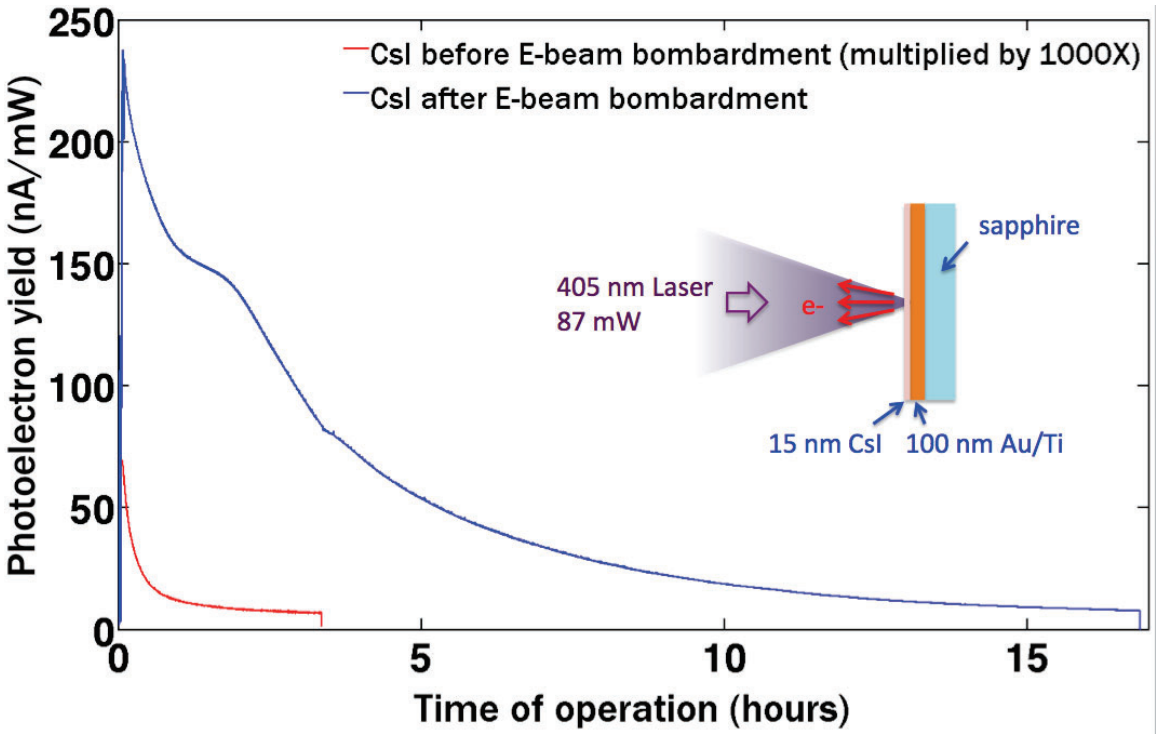

Figure 1: Photoelectron emission vs. time of a 15 nm thick CsI photocathode before (red line) and after (blue line) 1 keV electron beam bombardment. The inset shows the photoelectron emission configuration. Note that the photoelectron yield of the red line was multiplied by 1000.