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Impact of Surface Cleaning on the Quantum Efficiency of Mg Photocathodes

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Many experiments in biomedicine, security imaging, and condensed matter physics require high brilliance and moderate electron beams. The properties of the photo electron source is defined by the photocathode quality such as low thermal emittance, fast response time, high quantum efficiency (QE) and the photocathodes'robustness.
Metal cathodes are commonly used in RF Guns because they work robustly and tolerate poor vacuum compared to semiconductor photocathodes. However, metal cathodes only provide low quantum efficiencies in UV range and the most prerequisite for improving the QE is to produce an atomically clean surface. At ELBE, a successfully established process for improving the QE of Mg is laser cleaning [1]. Although this method improves the QE, a non-uniform surface and potential damage of the Mg photocathode arise at the same time. Ideally, an alternative process producing an atomically clean, smooth, and damage-free surface is desired.

In this work, we evaluate and discuss the effect of different surface cleanings, including hydrogen ion cleaning and thermal surface cleaning under UHV conditions, on the QE of Mg photocathodes, with the help of in-situ X-ray photoelectron spectroscopy (XPS).

References
[1] Teichert, J. et al. Successful user operation of the superconducting radio-frequency photo electron gun with Mg cathodes at ELBE. Phys. Rev. Accel. Beams 24, 1–30 (2021).

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