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n-machining, surface analysis and characterization measurements of a copper photocathode at SPARC_LAB

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An R&D activity on Cu photocathodes is under development at the SPARC_LAB test facility in order to fully know and characterize each stage of the photocathode life and to have a complete overview of the photoemission properties of the cathodes for high brightness electron beam photoinjectors. The n-machining process presented here consists in diamond milling, afterwards blown with clean air. This procedure shows a sensitive reduction of the roughness of the cathode surface and avoids surface contamination caused by other procedures, for example the polishing with diamond paste or the machining with oil. Both high roughness and surface contamination cause an increase of thermal emittance and consequently a reduction of the overall electron beam brightness.
We present Scanning Electron Microscopy (SEM), Energy Dispersive Spectroscopy (EDS) and Atomic Force Microscopy (AFM) techniques used to analyze the cathode surface, roughness, morphology and its chemical composition. The analysis of Cu photocathode, polished by diamond paste procedure, shows the degradation of the photoemission properties caused by breakdowns in the RF gun and the Silicon contamination due to the polishing procedure. The same cathode is analyzed after n-machining and results show a cathode surface with roughness of the order of few nm (rms) and the absence of silicon contaminants.
We also present the intrinsic emittance and quantum efficiency measurements before and after n-machining in order to know the n-machining effects.

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