Evaluation of Electron Energy Spread in CsBr Based Photocathodes

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Photocathodes with relatively low energy spread (<0.5 eV) are required for electron sources in several applications including single and multiple electron beam inspection and lithography tools and free electron lasers. CsBr based photocathodes have been shown to be very robust and capable of operation at high current density (>150A/cm^2) with very long lifetime (~hundreds of hours/spot). Experimental results of the photoelectron energy spread obtained in CsBr films deposited on both metal and InGaN substrates will be presented in this paper. The electron Source Development Test stand (SDT) installed at the Stanford Synchrotron Radiation Laboratory (SSRL) was utilized to obtain data in the transmission mode at 257nm photon energy and relatively high current density >100A/cm^2. Several types of energy analyzers were designed and installed in the SDT system to extend its photoemission measurements capabilities for energy spread measurements. One type of analyzer utilized in our experiments was a Faraday cup covered with a dense Au grid operated in a retarding field mode. Calculations for the intrinsic resolution of the Faraday cup analyzer and an optimized conventional analyzer now installed in the SDT system are shown in Figures 1 and 2 respectively. Preliminary experimental results obtained utilizing the Faraday cup analyzer are shown in Figure 3 for an InGaN/CsBr photocathode. The energy spread appears to be less than 0.4 eV which agrees with previous measurements in cesiated GaN photocathodes without the CsBr films. Results obtained with the optimized energy analyzer will be presented in the paper.

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dI/dV Curve and Intrinsic Energy Spread Resolution

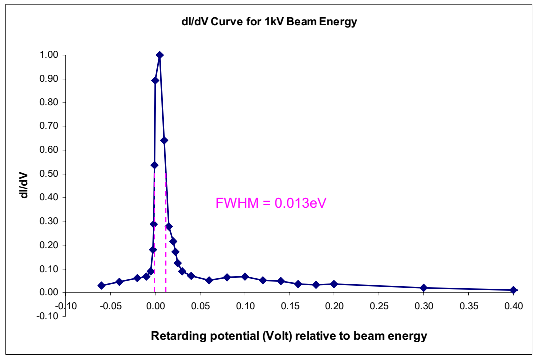

Figure 1. Calculated intrinsic resolution of a Faraday cup analyzer utilized in our experiments.

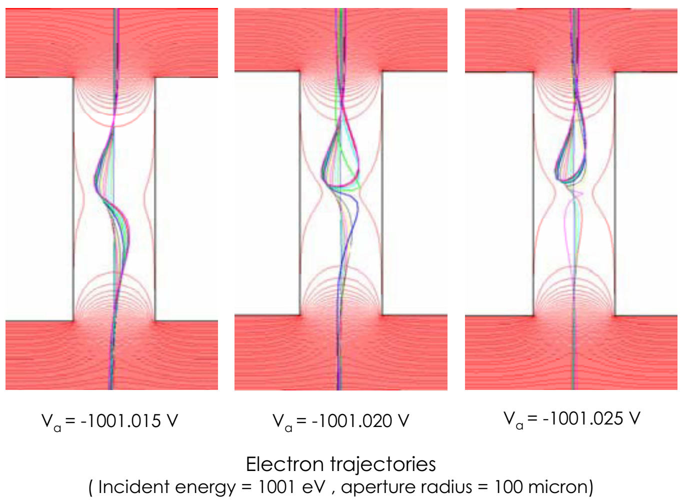

Figure 2. Calculated electron trajectories for a conventional retarding field energy analyzer with an optimized ratio of aperture/thickness. The intrinsic resolution is better than 10 mV.

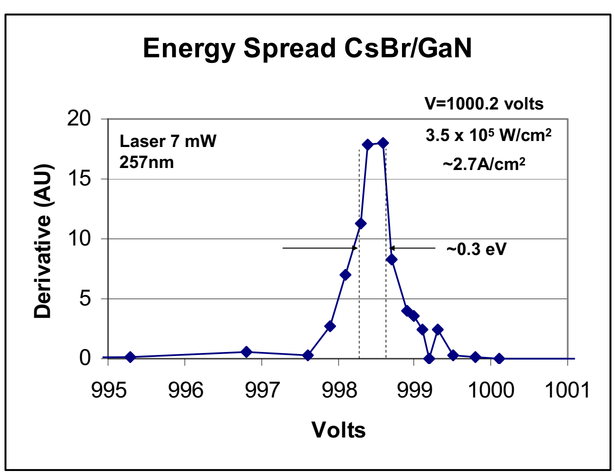

Figure 3. Preliminary results of electron energy spread obtained with a retarding potential Faraday cup analyzer in an GaN/CsBr photocathode