Wednesday Afternoon, October 30, 2013

Vacuum Technology
Room: 202 C - Session VT+AS+SS+TF-WeA

Surface Science for Accelerator Applications
Moderator: Y. Li, Cornell University

4:00pm **VT+AS+SS+TF-WeA7 Growth and Characterization of High Quantum Efficiency Photocathodes for the Cornell ERL R&D Project**, ***L. Cultrera***, *I. Bazarov, B. Dunham, Y. Li, X. Liu, A. Bartnik, K. Smolenski, S. Karkare, W. Schaff, T. Moore*, Cornell University **INVITED**

Electrons generated by photoemission process are nowadays recognized as the brighest beams source to drive X-ray Free Electron Lasers or Energy Recovery Linacs. Part of the Cornell University ERL R&D project is aimed at developing photocathodes for electron guns that can support the production of very high brightness beams with high average current for extended periods of time

We focused our studies to III-V semiconductors activated to negative electron affinity and to alkali antimonide semiconductors.

Both classes of materials show high quantum efficiency on the visible part of the spectrum but are extremely sensitive to poor vacuum conditions.Because of this a dedicated apparatus consisting of different interconnected UHV chambers has been realized in the phtocathode lab. This allows transferring samples from preparation to analysis chamber while keeping them under UHV. A movable vacuum suitcase is used the transfer selected samples from the photocathode lab to the photoinjector.

The procedure and challenges for preparing high quantum efficiency photocathodes will be illustrated as well as the characterization performed in photocathode lab and by using them in the photoinjector.

Aiming at a better understanding of the photemission process we recently developed a Montecarlo code to simulate the photoemission from GaAs activated to negative electron affinity. This tool will eventually guide us in engineering new photocathode materials.

Perspectives for further development on the generation of high brightness electron beams will be discussed.

5:00pm **VT+AS+SS+TF-WeA10 Photocathode Materials Able to Sustain High Currents**, ***Z. Li***, *K. Yang, L. Wang, J. Riso, R.A. Lukaszew*, The College of William and Mary

We will present preliminary work on photocathode materials able to sustain high currents, pertinent to the technology of accelerators and associated systems and essential to develop strategies and technologies for next generation nuclear physics accelerator capabilities. To this end, metallic photocathodes offer several clear advantages over semiconductor photocathodes because they are robust against degradation due to surface contamination and against damage resulting from conditioning or heating and can withstand high electric surface fields present at the cathode in RF accelerators. Other advantages include their very short response time (less than picoseconds) and their very long lifetime (years or longer), which is much longer than of other types of photocathodes (hours to months). However, the main problem with metallic photocathodes is the rather low quantum efficiency (QE), even for UV radiation. A possibility to improve the QE of metallic photocathodes is to exploit surface plasmon resonance using adequate geometries for the intended application, as well as possible cap layers able to lower the metal work function. In this way, metal photocathodes designed to support surface plasmons could produce high electron yields by enhancing their QE. We will show design criteria for such platform for this application as well as our preliminary results.

5:20pm **VT+AS+SS+TF-WeA11 Quantum Efficiency and Divergence from Metal Photocathodes**, *T. Vecchione, D.H. Dowell*, SLAC National Accelerator Laboratory, *J. Feng, W. Wan*, ***H.A. Padmore***, Lawrence Berkeley National Laboratory

Quantum efficiency and divergence are key parameters for measuring photocathode performance. This work presents new theoretical expressions for each quantity and experimental confirmation of each expression with respect to excess energy. Novel instrumentation and analysis techniques developed are described in detail. The data obtained from polycrystalline metal thin films matches reasonably well to that which is theoretically predicted.

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