Joint DESY and University of Hamburg Accelerator Physics Seminar

Monday October 4, 2004

(14:00 in Room 459/30b)

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Three Talks on Photocathode Guns

1. Properties of field emission dark current from Molybdenum and Titanium electrodes

Abstract

The dark current generally contains two components produced by the primary field emission from cathode and the secondary enhancement effect due to electron and ion bombardments of anode and cathode. However, using the dark current dependence on the electrode gap separation we can separate these components. By analyzing the observed dark currents from Molybdenum (Mo) and Titanium (Ti), it is shown that Mo exhibits very low primary field emission current as a cathode, while Ti exhibits a lower enhancement effect as an anode. An electrode configuration of Mo cathode and Ti anode is thus examined, and it is confirmed that a field gradient as high as 130MV/m is possible for 1nA total dark current for a gap of 0.5mm and an effective cathode area of 7mm^2. A local field enhancement factor beta of 29 is obtained by FN plot for this electrode.

2. Present status of 200keV polarized electron gun at Nagoya University

Abstract

A proto-type of 200 keV electron gun for a future LC (linear collider) and/or ERL (energy recovery linac) has been constructed at Nagoya University. The degradation of NEA (negative electron affinity) surface of GaAs photocathode is known as a major problem for such a high field-gradient gun, since it is required to produce low emittance and/or high intensity beam. In order to improve an insufficient NEA lifetime (≈25h) for the initial gun operation, the vacuum pumping speed was reinforced using non-evaporable getter (NEG) pump modules. As a preliminary result, the total pressure was improved to $5.7 \cdot 10^{-10}$Pa from $3.2 \cdot 10^{-9}$Pa and the lifetime was extended to ≈150 hours. A relation between the NEA lifetime and the partial pressures of CO_2 and H_2O was evaluated by assuming a simple model of NEA degradation. An emittance measurement system based on a pepper pot method was also build and a preliminary measurement has been started.

3. Recent PES Photocathode R&D at Nagoya University

Abstract

Strained-layer superlattice structures have been presenting the most promis ing performance as a photocathode for the polarized electron source (PES). I n our experiments, the GaAs-GaAsP photocathode achieved maximum polarization of 92±6% with quantum efficiency of 0.5%, while the InGaAs-AlGaAs photocat hode provided higher quantum efficiency (0.7%) with lower polarization (77±5%). Criteria for achieving high spin polarization and high quantum efficien cy using superlattice photocathodes were clarified by employing the spin-res olved quantum efficiency spectra. However, it seems that major problems remained for the PES R&D are to improve (1) beam emittance and (2) NEA lifetime under gun operations for high peak current and high average current, respectively. In order to overcome these problems simultaneously, we started a development of a new type photocathode using field emission mechanism. First, we tried to use a pyramidal shape GaAs (tip-GaAs). Using the tip-GaAs, electrons can be emitted from a small area at the top of pyramid, and thus the beam emittance is expected to be small. This emission mechanism also enables to extract electrons from the poor NEA or small PEA surface into vacuum, and it helps to relax the NEA lifetime problem. Preliminary results will be reported in this workshop.

NOTE THE UNUSUAL DATE AND TIME

D.P.Barber (MPY), J.Rossbach (Univ. HH), P.Schmüser (Univ. HH), and M.Vogt (MPY).