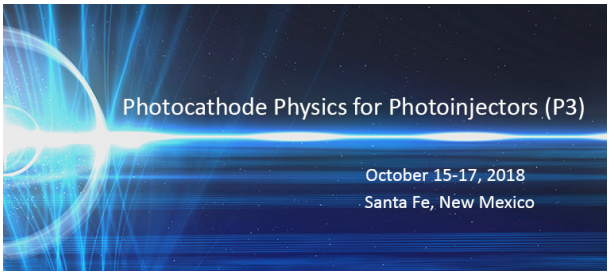

Contribution ID: **24** Type: **not specified**

Semiconductor photocathode in a transmission electron microscope

Monday 15 October 2018 17:05 (20 minutes)

We have demonstrated that the SPTEM can provide both TEM images and diffraction patterns. The TEM images were obtained at a spatial resolution of 1 nm with a 30-kV acceleration voltage. The apparatus has an electron beam energy width below 114-meV in the TEM without any monochrometors. The energy width indicates that the temporal coherence is approximately 34 fs. The brightness is measured by taking a spot size and a convergent angle on an image plane. The measured brightness is approximately 4 × 107 A cm−2 sr−1 at 30-keV beam energy with a polarization of 82% and a drive-laser power of 800 kW/cm2 on the photocathode. The brightness for 200-kV beam energy is estimated to be 3 × 108 A cm−2 sr−1, which is converted using a Lorentz factor. The order of the brightness is sufficient for an interference experiment. Therefore, we could demonstrate interference fringes of a spin-polarized electron beam using a newly installed biprism. The resulting electron beam exhibits a long coherence length owing to its low initial emittance of 2.6 nm rad, which can generate interference fringes representative of a first-order correlation using an electron biprism. These results indicate that the SPTEM can provide enough coherence in both the lateral and longitudinal directions even if the semiconductor photocathode is used for an electron emitter.

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Session Classification: Session 4

Track Classification: Session 4: Application Oriented Research: Spin Polarized Sources