The Beams and Applications Seminar Series

Diamond amplifiers for photocathodes

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Host: C.-x. Wang, ASD

The generation of high-brightness, high-average-current electron beams opens up new possibilities in a variety of fields, from 100's of kilowatt average power FELs, ultra-high brightness and flux Energy Recovery Linac based synchrotron light sources, electron ion colliders of extreme luminosity and much more. It is a great challenge to get both the small emittance beams (on the order of one micron) and the high average current (on the order of a good fraction of an ampere) from the photocathode and electron gun. We report a new approach to the generation of high-current, high-brightness electron beams. Primary electrons are produced by a photocathode and are accelerated to a few thousand electron-volts, then strike a specially prepared diamond window. The large Secondary Electron Yield (SEY) provides a multiplication of the number of electrons by about two orders of magnitude. The secondary electrons drift through the diamond under an electric field and emerge into the accelerating proper of the electron gun through a Negative Electron Affinity surface of the diamond. The advantages of the new approach include the reduction of the number of primary electrons by the large SEY, i.e. a very low laser power, low thermal emittance due to the NEA surface and the rapid thermalization of the electrons, protection of the cathode from possible contamination from the gun, and of the gun from possible contamination by the cathode. This presentation will cover the criteria that need to be taken into account in designing the amplifier and experimental data, among other things showing measurements of SEY of a few hundred, transport across hundreds of microns of diamond window and emission into vacuum.

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