Licensable Technologies

Room Temperature Dispenser Photocathode

Applications:

- Medical X-ray imaging
- National security X-ray imaging
- Radio-frequency linear accelerators
- Free-electron lasers (FELs)
- Particle accelerators

Benefits:

- Up to 100-times increased operational lifetime
- Reduced system size
- Improved electron beam brightness and quality
- Diminished complexity
- Reduced operational / maintenance costs

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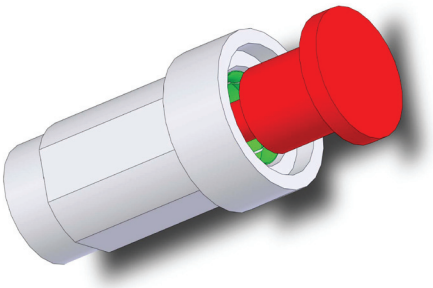
Summary:



High-efficiency photocathodes with long operational lifetimes can be useful in a variety of commercial applications, enabling technologies in free-electron lasers (FELs) and replacing thermionic emitters found in X-ray imaging sources and other devices requiring electron beams. The use of photocathodes, driven by a compact photo diode, can significantly reduce the form factor of devices depending upon the application, while offering a considerable reduction in power consumption and maintenance costs.

Typically, alkali-metal coatings with generally short lifetimes must be used in order to achieve the high photosensitivity, or quantum efficiency, necessary to produce useable photo-switched electron beams. The full potential of such cathodes has been historically limited because most applications, such as medical x-ray sources and high-power light sources (e.g., the free electron laser), cannot benefit from operational lifetimes outside of a few hours.

In order to address these issues, Los Alamos National Laboratory (LANL) researchers have developed the Room Temperature Dispenser Photocathode (RTDP), an improved cathode technology that addresses the intrinsic vulnerability of alkali-based photocathodes. In some cases, cathode lifetime can be improved by nearly two orders of magnitude without sacrificing high quantum efficiency. Current photocathodes degrade because cesium, the alkali material, leaves the emitting surface over the lifetime of the device. The RTDP, on the other hand, delivers cesium to the surface at the same rate at which it is lost, enabling the cathode to function for much longer periods at high quantum efficiency.

Though restoration of cesium atoms to the surface of a cathode had been previously attempted, these efforts suffered from low quantum efficiencies because the high temperatures that were required to replenish surface layers of cesium was also sufficient to cause chemical instability and rapid degradation of the entire cathode.

In contrast, the RTDP is a versatile cathode substrate system onto which many types of alkali-based photoemitters can be constructed and maintained. It consists of a porous cathode substrate hermetically mated to a cesium reservoir which is electrically activated. The cesium diffuses through the cathode barrier at a controlled rate, such that it replaces cesium at the cathode surface to dramatically increase cathode lifetime. The device produces a high-quality photo-gated (sub-picosecond response time) electron beam at room temperature for a long operational period and could potentially replace existing thermionic emitters in a multitude of applications for a significant reduction in size, complexity, and cost.

Development Stage: Working prototype

Patent Status: Patent pending

Licensing Status: Available for exclusive or non-exclusive licensing

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