
Modular Cathode for Micro Electron Beam Pumped Deep UV Laser

Technology #17550

Applications

This invention has immediate applications in the development of deep UV laser diodes emitting at wavelengths frequently used by the semiconductor industry for lithography processes. Additionally, the high current density and cathode longevity made possible by this invention means it has potential applications in fields like electron microscopy, infrared imaging, as well as high power and high frequency electronics.

Problem Addressed

Field emitter arrays are a class of cathodes that can operate at room temperature, making them attractive candidates for use in electron beam sources. However, their adoption to date has been limited by low current density and short life. This invention describes a modular cathode design that addresses these challenges.

Technology

The modular cathode described in this invention consists of an array of field emitter elements, each of which comprises a nanoscale field emitter tip supported by a high-aspect ratio silicon column. An annular gate electrode is located around each emitter tip. When a voltage is applied between gate electrodes and emitter tips, the resulting concentrated electric fields cause electrons to be emitted from the tips.

An electron-transparent, gas-impermeable membrane covers the aperture of each gate electrode, allowing emission of electrons while protecting the emitter tip from erosion by gaseous ions created when electrons collide with gaseous molecules downstream. In addition, the membrane also forms a hermetic seal around the emitter tip. This allows the high vacuum necessary for optimal emitter operation to be restricted to a small region around the tip. More generally, it allows the cathode to be packaged as a well-encapsulated module that can be optimized without affecting downstream processes making use of the electron beam.

Advantages

- High current density and long cathode life
- Capable of room temperature operation
- Modular architecture allows decoupled optimization and compatibility with a wide range of downstream processes

Categories For This Invention:

Electronics & Circuits
Semiconductors & Integrated Circuits
Semiconductor Manufacturing
Photonics
Sources

Intellectual Property:

Compact modular cathode
Issued US Patent

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External Links:

Microsystems Technology Laboratories
<http://www-mtl.mit.edu/~akinwand/index.html>

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