CNT-Based Devices Using Thin-Film Technologies

A thin-film triode design for CNT-based field emission to reduce the size and increase the efficiency of carbon nanotube (CNT)–based field emission devices

Georgia Tech researchers and ELSYS and SSC Pacific, respectively, have developed a thin-film triode design for CNT-based field emission to reduce the size and increase the efficiency of carbon nanotube (CNT)–based field emission devices, taking a major step toward achieving a portable source for electrons. This innovative triode design uses a dielectric layer to separate a conductive substrate from a counter-electrode (or gate electrode). Isotropic wet etching of an array of micron-scale pits in the dielectric layer enables bundles of CNTs to be synthesized in each pit through chemical vapor deposition. This approach creates a buffer zone around the CNTs, ensuring they are close to—but do not contact—the gate, which would cause a short. This design achieved a current density of 293 uA/cm^2 at 200 V in a lightweight package, enabling the development of portable electron source devices.

Summary Bullets

- Requires very low operating voltage
- Yields a compact field emitter package
- Avoids electrical shorts caused by emitter-gate contact

Solution Advantages

- Requires very low operating voltage
- Yields a compact field emitter package
- Avoids electrical shorts caused by emitter-gate contact
- Offers better fabrication, eliminating construction and emitter growth defects

Potential Commercial Applications

- Spacecraft electric propulsion
- Field emission (flat panel) displays
- X-ray sources
- Telecommunications equipment
- Lighting
- Vacuum electronics devices

Background and More Information

Having a lightweight, efficient source of electrons is a major goal for spacecraft electric propulsion systems as well as a range of other applications. CNTs offer great promise for improved field emission performance given their very high electrical conductivity, high temperature stability, chemical inertness, and nanoscale geometry. However, CNT-based emitters face significant fabrication challenges. There is a need for a innovation that addresses those challenges.

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Patent has issued<o:p></o:p> : US9058954

Publications

Operation of Spindt-Type, Carbon Nanotube Cold Cathodes in a Hall Effect Thruster Environment, IEEE Transactions on Plasma Science - 2014

Images

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