URN etd-0407109-183713-1035
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Statistics This thesis had been viewed 41 times. Download 0 times.
Department
Year 2007
Semester 1
Degree Master
Type of Document Master's Thesis
Language zh-TW.Big5 Chinese
Title Cold-Cathode Electron Emitters Based on Porous Silicon Structures
Date of Defense 0000-00-00
Page Count 83

Keyword
Porous silicon
Field emitter
Ballistic emission

Abstract
According to the related researches, the emitting efficiency of Porous Si (PS) electron-emitting devices is mainly limited by the non-uniform electric field distribution in the PS layers. In this thesis, we successfully improved the emitting characteristics of conventional single-PS-layered electron-emitting devices by use of PS layers with low/high porosity structures, in which the distribution of electric field were distributed more uniformly.
The low/high porosity PS structures had been formed by modulated-etching-current technologies and characterized by HR-SEM and AFM. We evaluated the electric conductivity of the Au films deposited on the PS layers by a Hall-Measurement System. Finally the emission performances of electron-emitting devices were measured by I-V measurements.
Experimental results showed that the Au films deposited on the low-porosity PS layer possessed higher electric conductivity. With low-porosity PS layers as the top layers of electron-emitting devices, the Au films deposited on PS layers had better uniform potential distribution.
Electron-emitting devices with optimum low/high porosity PS structures had been formed for testing. The maximum field emission currents and efficiency of the devices were 457 times and 910 times than those of single-layered PS ones, respectively. The turn-on voltages of devices with low/high porosity PS structures were lower than those of single-layered PS ones by 10V. These enhanced emitting characteristics were owing to the introduction of high-porosity PS layers in the devices, which led to much more uniform electric-field distribution within the low-porosity PS layers that acted as the main electron emitting zones.
Experimental results verified that PS electron emitters with low/high porosity structures achieved larger emitting current, higher efficiency, and lower turn-on voltages. Therefore, these structures possessed very high potential in development of high-efficient FED.
Advisory Committee - advisor

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Date of Submission 2008-08-01