Session 21. Field emssion / Cold cathodes / Scandate cathodes

May 1 (Wednesday) / 10:00 ~ 11:40 / Room 3

Session Chair: Kyu Chang Park (Kyung Hee University, Korea)

10:00 ~ 10:20

21.1 / Quality and Performance of Commercial Nanocomposite Scandate Tungsten Material

Michelle Gonzalez (University of California, USA), Neville C. Luhmann Jr. (University of California, USA), Diana Gamzina (SLAC National Accelerator Laboratory, USA), Colin McElroy (Vacuum Process Engineering Inc., USA), Carl Schalansky (Vacuum Process Engineering Inc., USA)

Nano-composite scandate tungsten cathodes have been demonstrated to have superior performance to other thermionic cathodes by researchers worldwide. Focus on quality and its relationship to emission performance is essential for transferring this transformational material technology to commercial applications. Metrics for evaluation of powder quality, sintered pellet quality, and emission performance have been established and are employed for manufacture of commercially viable large batch scale production process.

10:20 ~ 10:40

21.2 / High-Performance Scandate Cathode

Daniel E. Bugaris (Engi-Mat Co., USA), Claudia Goggin (Engi-Mat Co., USA), Xiaomeng Zhang (University of Kentucky, USA), John Balk (University of Kentucky, USA), Daniel Busbaher (a 3M Company, USA), Jack Tucek (Northrop Grumman Corporation, USA)

Scandate cathodes have long attracted attention due to their higher emission current density, apparent low work function, and anticipated improved longevity compared to conventional cathodes. However, scandate cathodes have not been applied as extensively as their potential would imply. In this study, the compositional homogeneity of a scandia/tungsten composite powder was investigated by scanning electron microscopy, X-ray energy dispersive spectroscopy, and X-ray photoelectron spectroscopy. From these techniques, a sample providing the optimal coverage of tungsten by scandia particles was then chosen. A cathode fabricated from this sample displayed a greater than 200°C decrease (improvement) in knee temperature versus the standard M-type cathode.

10:40 ~ 11:00

21.3 / Exact Analytical Solution for Ultrafast Electron Emission Due to Two-Color Laser Fields

Yi Luo (Michigan State University, USA), Peng Zhang (Michigan State University, USA)

This paper presents an analytical model for ultrafast electron emission from a metal surface illuminated by two-color continuous laser fields. The exact solution is valid for arbitrary fundamental and harmonic laser frequencies, laser intensities, phase difference between the two lasers, metal work function and Fermi level. We found two-color laser fields can strongly modulate the emission current up to 99%. Our results are in excellent agreement with recent experiments.

11:00 ~ 11:20

21.4 / Alignment of Carbon Nanotubes inside the Fibers Through Interfacial Interaction of Nanoparticles for Using as Cathode for Field Emission

Muhammad Mohsin Hossain (Seoul National University, Korea), Dongpyo Hong (Seoul National University, Korea), Matlabjon Sattorov (Seoul-Teracom, Inc. / Advanced Institutes of Convergence Technology, Korea), Seontae Kim (Seoul National University, Korea), Gun-Sik Park (Seoul National University, Korea)

Alignment of carbon nanotubes (CNTs) inside the CNT fiber is very important for the fast electron movement through CNTs. We utilized nanoparticles, such as ZnO for the alignment of CNTs and described how semiconducting ZnO can act as an alignment agent in carbon nanotubes (CNTs) fibers. Due to the alignment of CNTs through the ZnO nanoparticles linking groups, the CNTs inside the fibers were equally distributed by the attraction of bonding forces into sheet-like bunches, such that any applied mechanical breaking load was equally distributed to each CNT inside the fiber, making them mechanically robust against breaking loads. Although semi conductive ZnO nanoparticles were used here, the electrical conductivity of the aligned CNT fiber was comparable to bare CNT fibers, suggesting that the total electron movement through the CNTs inside the aligned CNT fiber is not disrupted by the insulating behavior of ZnO nanoparticles. Due to the high electrical, mechanical, and thermal properties of CNT fiber, it is a good candidate as field emitter. For using CNT fiber as cathode for sheet beam, CNT fiber further was converted to the sheet structure, which are more important for getting sheet.

11:20 ~ 11:40

21.5 / Fabrication of high current carbon nanotube based cold cathode emitters and applications

Hye In Lee (KyngHee University, Korea), Jung Su Kang (KyngHee University, Korea), Kyu Chang Park (KyngHee University, Korea)

We developed high current electron emission carbon nanotube cold cathode electron sources for high power vacuum devices. To develop high power devices with electron beam, electron emission current is most important. More than 100 mA electron emission current achieved with the optimized CNT fabrication process and its structure. The electron emission current limited by the conductivity of CNT emitters, the higher conducting emitters show higher electron emission current. Detail on the fabrication process and performance of electron beam would be presented.