Session 12. Thermionic cathodes

April 30 (Tuesday) / 10:20 ~ 12:20 / Room 3

Session Chair: Jun Chen (Sun Yat-sen University, China)

10:20 ~ 10:40

12.1 / [Keynote] Space Qualification of M- and MMC-type Cathodes at High Current Density

Christof Dietrich (Thales Germany / MIS, Germany), Jean-Michel Roquais (Thales AVS / MIS, France), Justin Demory (Thales AVS / MIS, France), Frédéric André (Thales AVS / MIS, France)

The need for higher current densities in combination with a long lifetime in recent TWT development, in particular in Q-band, drives a permanent improvement of cathode technology, models and operating conditions at Thales. Building on the very positive on-orbit experience with the M-type cathode up to 2.5 A/cm^2 we show in this presentation that this cathode can safely operate at 4 A/cm^2 for a space mission with a lifetime exceeding 15 years provided that its operating temperature is adequately adjusted. In parallel Thales is pursuing the development of an improved MM-type cathode doped with chromium (so-called MMC-type) targetting a qualification at 5 A/cm^2. We update on the latest results.

10:40 ~ 11:00

12.2 / Thermally Assisted Photoemission of CeB_6 at High Temperatures

Konstantin Torgasin (Kyoto University, Japan), Kenichi Morita (Kwawsaki Heavy Industry, Ltd., Japan), Heishun Zen (Kyoto University, Japan), Kai Masuda (Kyoto University, Japan), Toshiteru Kii (Kyoto University, Japan), Kazunobu Nagasaki (Kyoto University, Japan), Hideaki Ohgaki (Kyoto University, Japan)

Photocurrent of CeB_6 was measured over wide range of temperature. The photocurrent at high temperature exceeds the value expected by the Fowler-DuBridge theory. A transmission coefficient was introduced to the photoemission equation in order to account for electron escape probability. The fitting of measured data reveals that the transmission coefficient can not explain the rise in photocurrent at high temperatures for different photonenergies.

11:00 ~ 11:20

12.3 / Study on the thermal effect of photon-induced electron emission enhancement

Yanxiao Guo (Southeast University, China), Hehong Fan (Southeast University, China), Hang Du (Southeast University, China), Xiaohan Sun (Southeast University, China), Zhengqiang Bao (Nanjing Sanle Group Co. Ltd, China), Tian Liang (Nanjing Sanle Group Co. Ltd, China), Wenjing Hu (Nanjing Sanle Group Co. Ltd, China)

In order to investigate the thermal effect of photon-induced enhancement of electron emission, emissions from a diode with coated Ba-W cathode under different temperature & voltage conditions, and under certain irradiation of ultraviolet light were detected. The measured results were compared with theoretical results of thermo-optical-emission. Experiments showed that, the measured photon-induced enhancement of electron emission, as well as the quantum efficiency, remained almost the same at low values within a large temperature range, but increased dramatically from temperatures 100K-400K below the normal cathode operation temperature, with the maximum quantum efficiency reached 6.0×10^{-2} at 1290K. Furthermore, apparent peaks appeared on tested ΔI-Va curves near knee-voltage points, which demonstrated different tendencies than theoretical estimated results.

11:20 ~ 11:40

12.4 / The work function of the Ammonium Perrhenate Impregnated W Matrix Ba-W Cathode

Wang Xiaoxia (Chinese Academy of Sciences, China), Xiaoqian Chen (Chinese Academy of Sciences, China), Shuai Zhang (Chinese Academy of Sciences, China), YUN li (Chinese Academy of Sciences, China), Qi Zhang (Chinese Academy of Sciences, China)

In this paper we mainly describes the research progress in a kind of ammonium perrhenate impregnated W matrix Ba-W cathode, which includes the work function measuring and the lifetime testing of the cathode. The work function measuring results shows that the initial practice work function of the cathode is 1.75eV. After 41571h lifetime at a temperature of 1000º Cbr ~ 1010º Cbrand a dc load of 3.0 A/cm^2, the practice work function increase to 1.84eV.

11:40 ~ 12:00

12.5 / Statistical Model of Non-Uniform Emission from Polycrystalline Tungsten Cathodes

Dongzheng Chen (University of Wisconsin-Madison, USA), Ryan Jacobs (University of Wisconsin-Madison, USA), Vasilios Vlahos (L3 Technologies, USA), Dane Morgan (University of Wisconsin-Madison, USA), John Booske (University of Wisconsin-Madison, USA)

We have constructed a model capturing the statistical nature of non-uniform thermionic electron emission from polycrystalline W cathodes. This model incorporates the proportion of different crystallographic emitting surfaces from commercial cathode samples via electron backscatter diffraction (EBSD), the effects of surface roughness from optical interferometry measurements, and surface-specific work function values calculated using density functional theory (DFT). Using this model, we aim to calculate 2D emission maps and the corresponding Miram curves for real cathodes. This model provides a pathway to understanding the complex physics of emission from inhomogeneous cathode surfaces, which is a key issue for the commercial production and use of impregnated cathodes in vacuum electronic devices.

12:00 ~ 12:20

12.6 / LaB_6 cathode workfunction and operating temperature

Victor Katsap (NuFlare Technology America, Inc., USA), Chising Lai (NuFlare Technology America, Inc., USA)

LaB_6 cathode is the emitter of choice in electron beam lithography tools. We have devised and implemented simple, robust technique for evaluating LaB_6 cathode workfunction (WF), and studied workfunction-operating temperature relationship.