Session 15. Magnetrons and CFA

April 30 (Tuesday) / 13:30 ~ 15:10 / Room 3

Session Chair: Jung-Il Kim (Korea Electrotechnology Research Institute, Korea)

13:30 ~ 13:50

15.1 / [Keynote] A Study of Harmonic Locking Between Oscillators in a Dual Frequency Magnetron

Drew A. Packard (University of Michigan, USA), Geoffrey B. Greening (CPI, USA), Nicholas M. Jordan (University of Michigan, USA), Steven C. Exelby (University of Michigan, USA), Y.Y. Lau (University of Michigan, USA), Ronald M. Gilgenbach (University of Michigan, USA), Brad W. Hoff (Air Force Research Lab, USA), Jason F. Hammond (Air Force Research Lab, USA)

The Harmonic Recirculating Planar Magnetron (HRPM) is a crossed field microwave source capable of oscillating at high power, potentially at four different frequencies from L-Band to S-Band. In a previous experiment, the two oscillators of the Multi-Frequency Recirculating Planar Magnetron (MFRPM) exhibited harmonic frequency locking, where one oscillator at S-Band locked to the second harmonic of the other oscillator's L-Band resonant frequency. The HRPM has been designed to experimentally test the harmonic frequency locking concept.

13:50 ~ 14:10

15.2 / Experiments on a Recirculating Planar Crossed-Field Amplifier

Steven C. Exelby (University of Michigan, USA), Geoffrey B. Greening (University of Michigan, USA), Nicholas M. Jordan (University of Michigan, USA), Drew A. Packard (University of Michigan, USA), Yue Ying Lau (University of Michigan, USA), Ronald M. Gilgenbach (University of Michigan, USA), Brad W. Hoff (Air Force Research Laboratory, USA), David Simon (Air Force Research Laboratory, USA)

The Recirculating Planar Crossed-Field Amplifier (RPCFA) has demonstrated amplification in excess of 10 dB of a ~30 kW RF signal, with 15% bandwidth. The RPCFA is the amplifying adaptation of the Recirculating Planar Magnetron (RPM) also developed at the University of Michigan. Ansys HFSS and the particle-in-cell code MAGIC were used to design a prototype. The prototype RPCFA was constructed and demonstrated transmission characteristics similar to those predicted by simulation. Sustained amplification for pulses 100's of nanoseconds in length have been observed with peak amplification as high as 16dB and greater than 1 MW of output power. The RPCFA is shown to be unsaturated at the 10's of kW RF drive at which it has been tested, suggesting higher input drive power may lead to even greater output power. The range of amplifiable frequencies implied by the transmission band is verified experimentally. The lower limit for RF drive power that can be amplified is found to be approximately 100 W. Sources of irreproducibility of microwave gain are being investigated. Injection of higher drive power up to

1 MW is planned.

14:10 ~ 14:30

15.3 / Novel Cold Cathode Design for mm-wave (THz) Spatial Harmonic Magnetrons

Rajendra Kumar Verma (CSIR-Central Electronics Engineering Research Institute, India), Shivendra Maurya (CSIR-Central Electronics Engineering Research Institute, India), Rajendra Kumar Sharma (CSIR-Central Electronics Engineering Research Institute, India)

Cathode Emission for effective electron cloud/ plasma expansion is one of the prime physical mechanism influencing the performance of a magnetron with reference to efficiency and power levels. It essentially requires enhanced secondary electron emission by cold cathodes in mm/sub-mm wave (THz) spatial harmonic magnetrons (SHMs). The manuscript presents a novel cold cathode design named as interdigitated thermally assisted - secondary electron emission (T-SEE) cathode. CST-Particle Studio (CST-PIC) simulations of SHM with the proposed novel configuration cold cathode has resulted in 3kW power enhancement with 3.46% efficiency enhancement with reference to the conventional cold SEE cathode used in SHMs.

14:30 ~ 14:50

15.4 / A Novel Phase-locking Structure Applied to Millimeter-wave Magnetrons

Tianqi Hu (University of Electronic Science and Technology of China, China), Minsheng Song (University of Electronic Science and Technology of China, China), Yong Yon (University of Electronic Science and Technology of China, China), Bin Wang (University of Electronic Science and Technology of China, China), Hailong Li (University of Electronic Science and Technology of China, China), Lin Meng (University of Electronic Science and Technology of China, China)

A novel phase-locking structure of millimeterwave magnetrons is studied. The phases of multiple magnetrons can be locked by using this phase-locking structure. This phase-locking structure utilizes impedance transformation can be applied to continuous-wave magnetrons or pulse-wave magnetrons, generating multiple high-power in-phase outputs for power synthesis, etc. The purpose of this structure is to use less than 10 dB microwave power in the magnetrons for coupling to achieve phase locking, while most of the power can be effectively output. The structure has been studied by the resonant system of Ka-band rising-sun magnetrons.

14:50 ~ 15:10

15.5 / Tuning Characteristics Analysis of a Ka-band Coaxial Magnetron

Minsheng Song (University of Electronic Science and Technology of China, China), Tianqi Hu (University of Electronic Science and Technology of China, China), Yin Yong (University of Electronic Science and Technology of China, China), Lin Meng (University of Electronic Science and Technology of China, China), Hailong Li (University of Electronic Science and Technology of China, China), Bin Wang (University of Electronic Science and Technology of China, China)

In this paper, tuning characteristics of a Ka-band coaxial magnetron has been studied. The initial parameters of the coaxial cavity have been analyzed theoretically and verified by CST MW Studio. This paper summarizes some methods to optimize the parameters of coaxial cavity. Moreover, the characteristics of asymmetrical tuning is quantified by R/Q, quality-factor, the percentage of stored energy in coaxial cavity, as well as resonant frequency. It is simulated by CST MW Studio. Cold test is ongoing to verify the simulations.