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2P09 - Cold Test Validation of Metamaterial Based Rectangular Slow Wave Structure for High Power Backward-Wave Oscillators

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In this paper, novel S band metamaterial based rectangular slow-wave structure (RSWS) is proposed for high power backward-wave oscillator (BWO). The circular waveguide is loaded with R-SWS that shows negative permittivity and permeability. Since RSWS shows the negative permittivity and permeability which is the key characteristics of metamaterial, it can work below the cut-off frequency. A high frequency characteristic of SWS is analyzed using CST Studio Suite. Dispersion diagram of unit cell is observed with Eigen Mode Solver which is dedicated to simulation of closed resonant structure. Interaction impedance of the unit cell is also analyzed for future work. Since the beam-wave interaction occurs with TM mode, axial and absolute electric field is observed in the simulation. Slow wave structure composed of 8 unit cell is fabricated and measured in Network Analyzer. Cold-test measurement validates the TM mode propagation and dispersion diagram of RSWS. Hot test simulation is also achieved using CST Particle Studio. It is achieved for the 450 kV, 100 A annular electron beam under the 2 T analytical magnetic field with 10.7 MW peak power and % 23.8 peak efficiency at 2.49 GHz

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