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Abstract
The gyrotron backward wave oscillator (gyro-BWO) is a promising source of coherent millimeter wave radiation based on the electron maser instability on a backward waveguide mode. In this study, distributed wall losses and shortening the interaction length have adopted to enhance the stability of a W-band and Ka band gyrotron backward-wave oscillators (gyro-BWO). Simulation results reveal that distributed wall losses can effectively suppress high-order axial modes and do not significantly degrade the performance of a gyro-BWO operating at the fundamental axial mode. In contrast, shortening the interaction length can increase start-oscillation for all axial modes. In this study, the stationary nonlinear simulation code is employed to analysis, including the interaction length saturation characteristic, oscillation conditions of axial modes and transverse modes and frequency tuning range. Meanwhile, tapering waveguide structure is used for optimizing output power and bandwidth of gyro-BWO and increasing distributed wall losses is employed to enhance the stability of gyro-BWO. The stable gyro-BWO W-band is predicted to yield a peak output power of 100 kW at 96 GHz with an efficiency of 20 %, a half-power frequency tuning bandwidth of 1.8 GHz for a 100 kV, 5 A electron beam with an axial velocity spread of =5 %, and the stable gyro-BWO operating in the Ka band mode, is predicted to yield a peak output power of 233.7 kW at 36.32 GHz with an efficiency of 13 %, and a 3 dB frequency tuning ranges 0.82 GHz for a 120 kV, 15A electron beam with an axial velocity spread of. =8 %.
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