Planar FEM Resonator with Reflectors Composed by Bragg Gratings

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In this paper we discuss selective properties of planar reflectors composed by a pair of 1-D or 2-D Bragg gratings with various types of their surfaces corrugation. These reflectors can realize one- or two-dimensional distributed feedback in the resonator of a maser during generation of microwave radiation. Such reflectors are used at the ELMI-device that is operated at 75 GHz as FEM-oscillator driven by sheet electron beam [1]. In recent experiments at the ELMI-device its resonator consisted of two different reflectors. The first one is up-stream 2-D Bragg reflector, which provides synchronization of radiation across sheet electron beam. The down-stream 1-D Bragg reflector provides a sufficient reflectivity for the FEM self-excitation. Spectral properties of 1-D and 2-D reflectors and the resonator composed by them are investigated theoretically, in computer simulations and in "cold" measurements.

1-D Bragg reflectors with a special type of corrugation can be also used in planar FEMs for high efficiency output of generated power. The results of computer simulations for optimizing the corrugated surfaces to achieve maximum output power as well as result of "cold" measurements are presented in this paper.

We also carried out experiments at the ELMI-device on measurement of spectral properties of the radiation generated by the FEM-oscillator with Bragg reflectors. Results of the measurement at experiments with a sheet beam (cross section of the beam – 0.4x9cm, the electron energy ~ 1MeV, the beam current ~ 3 kA) and their discussion are also presented in the paper.

In addition, theoretical investigations have shown that 2-D Bragg reflectors can produce mutual exchange of transverse radiation flows between adjacent FEM-oscillators in a multichannel device and synchronize generation in the FEMs. According to this, 6..8 the same planar FEMs can be combined in a single superpower generator [2].

References

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