GYROTRON: LIMITS OF GROWTH

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Gyrotron are the most powerful sources of coherent millimeter and centimeter wave capable to operate in long - pulse and continuous regimes and successfully used for fusion experiments and advanced material processing. Until recently development new gyrotron intended mainly on increase of operating frequency, power and efficiency.

The power level of modern quasi-cw gyrotrons achieved up to 1 MW and there is an evident tendency to further increase of output power at least up to 1,5-2 MW [1-4]. The efficiency of best gyrotron tubes reaches without CPD (recovering of residual energy of worked-out electron beam) 40 % in continuous regimes and 50 % in pulse one, and achieves with one-step CPD 50 % in continuous regimes and 70 % in pulse regimes. The further increase of power and efficiency of gyrotrons is limited by several physical and technical reasons.

The complete gyrotron efficiency and maximum gyrotron power is defined by partial efficiencies and limiting capabilities of its subsystems: gun, beam tunnel, cavity, mode converter, output window, collector (with or without CPD). The cavity oscillation efficiency is reduced due to energy and velocity spread in a helical electron beam (HEB), ohmical cavity losses, mode competition, cyclotron reabsorption, static and RF space charge, etc. The importance of the specified factors differs in millimeter and centimeter frequency ranges and at different power levels. The comparative rating of influence of the specified factors is given.

The gyrotron output power restrictions caused by HEB formations system, cavity interaction processes, transmitting capability of an output window, stray radiation in the built-in converter and power dissipation on a collector are analyzed [1-5].

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References

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