INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Investigation on Different Aspects of the High-Power Coaxial Magnetron and RF windows operating in X-band

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SHORT ABSTRACT

The research deals with the various aspects of megawatt-class X-band pulsed power coaxial magnetron and RF windows. X-band magnetrons have a wide range of applications such as cargo scanning, medical linear accelerator (LINAC), and non-destructive testing and evaluation (NDT&E). High-power X-band magnetron is vital in developing a low cost and portable LINAC, which can also provide medical facilities to remote areas of the country. A systematic design procedure of coaxial magnetron is presented, which includes primary sub-parts such as a coaxial cavity, anode resonator, cathode, output section, unwanted mode suppressors, and frequency tuner. The simulation studies are performed using CST Studio, and some of the results are verified with the results in HFSS simulations. The output performance of the coaxial magnetron is analyzed using particle-in-cell (PIC) simulations. Output peak power of 2.12 MW with 62.04% total efficiency is achieved at 9.2987 GHz. The frequency tuning range is obtained as 9.2987 GHz ± 20 MHz. This thesis also examines high-power overmoded RF windows in X-band. Four ingenious designs of RF windows are proposed; three windows are based on the excitation of TE_{011} mode, and one window is based on the excitation of TE_{022} mode. Multiphysics and multipactor analyses are performed for the proposed RF windows.

A new approach for high-power coaxial magnetron using stacked anode resonators is proposed. A modified design of coaxial magnetron is presented with multiple anode resonators placed in a stack and multiple cathodes for high-power microwave generation. Since the output power of the conventional coaxial magnetron (with single anode resonator) is limited, and for high-power requirements, magnetron array is used. The phase-locking mechanism is essential for combining the output powers of multiple magnetrons because of their intrinsic phase inconsistency in the output signal. The proposed design enhances the output power of a coaxial magnetron substantially without requiring complex external circuitry for power combining.